17th AIRCRAFT PRODUCTION NUMBER—JULY, 1957

Machinery

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Machinery

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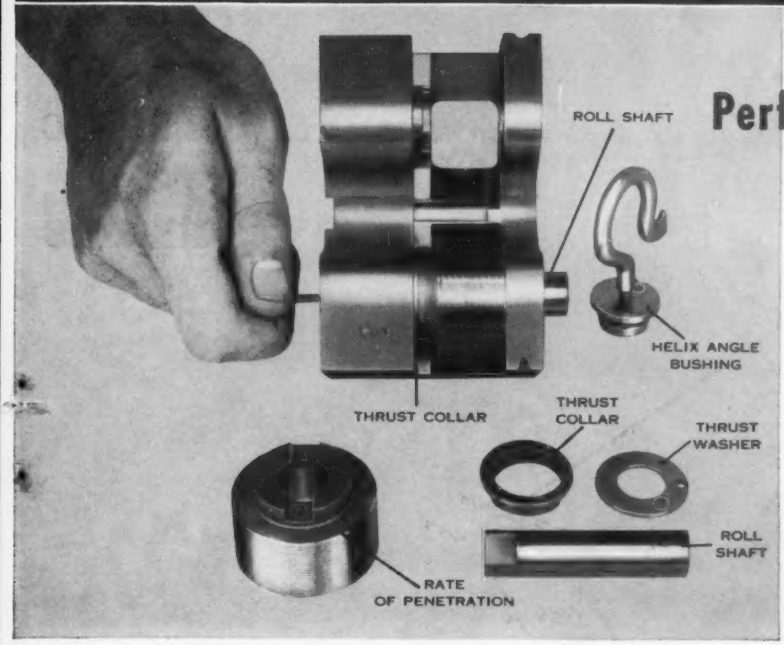
SHOP PRACTICE

MACHINE AND TOOL DESIGN

MANAGEMENT PROBLEMS AND MEETINGS

DEPARTMENTS

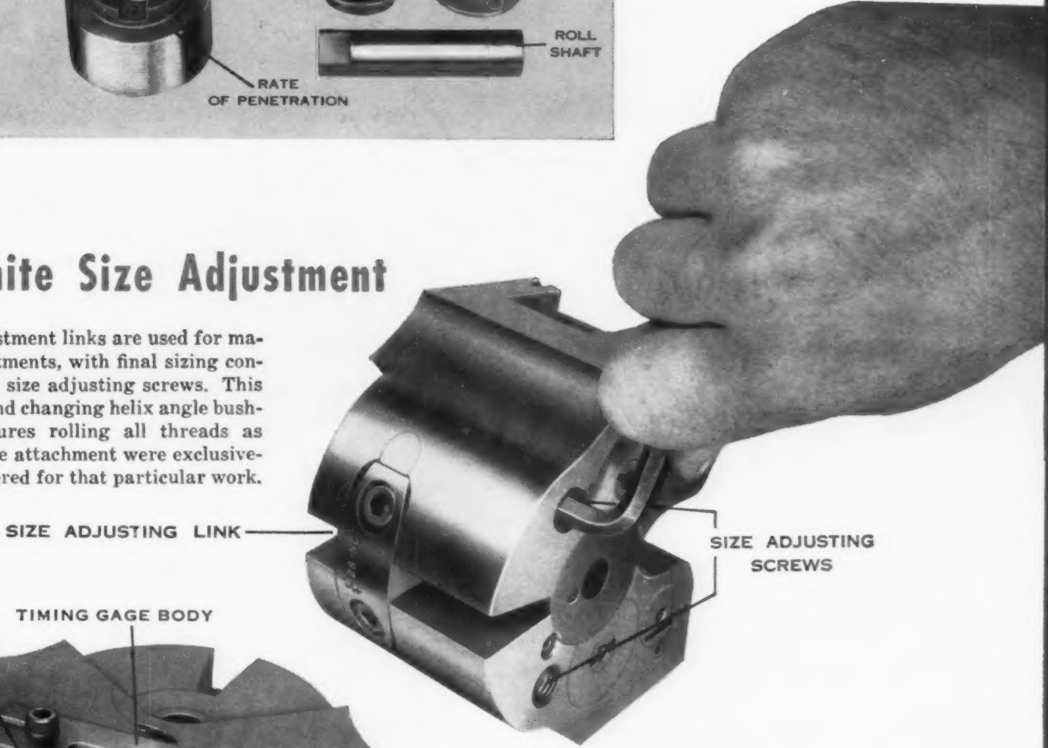


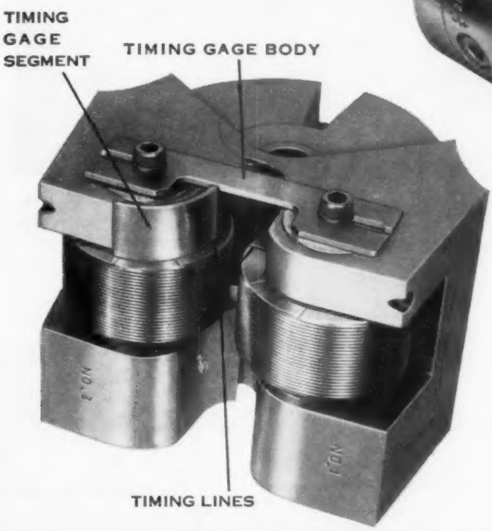
Perfect Helix Agreement

The helix angle bushings, thrust collars, and thrust washers provide a corrective between the workpiece and roll helixes, eliminating drunkenness and ensuring coarse pitch threads to Class 4 fit. All helix angle equipment is designed and marked for rapid changes.

Infinite Size Adjustment

Size adjustment links are used for major adjustments, with final sizing controlled by size adjusting screws. This system, and changing helix angle bushings, assures rolling all threads as though the attachment were exclusively engineered for that particular work.





Precise Timing

A simplified system of roll timing ensures satisfactory rolling on the first operation. Only one gage is used for timing all threads rolled by each attachment. Rolls are correctly timed when roll lines coincide with the vertical of the curved timing gage segment (illustrated).

For more information fill in page number on Inquiry Card, on page 259

"Putting the Finger" on supersonic demands

Fellows 3″ Fine Pitch Gear Shaper cutting precision spur gears at Hughes Aircraft. Cutter speeds as high as 2000 strokes per minute are used.

Fellows No. 4 Fine-Pitch Gear Shaver finishes Hughes gears to tolerances as close as 0.0003″ tooth-to-tooth composite error, 0.0005″ total composite error.

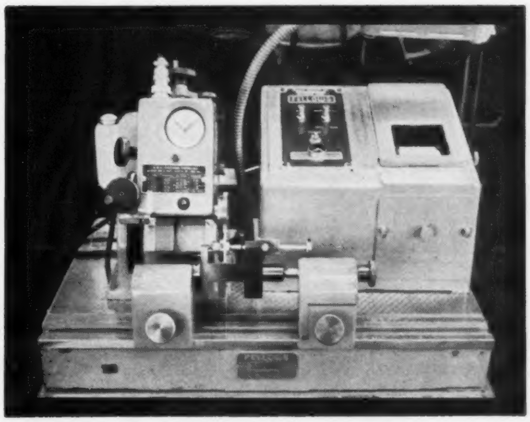
THE
PRECISION
LINE

targets

PRECISION GEARS...

Modern military aircraft travel 0.2 or more miles per *second*, missiles even faster! Control systems for detection and interception at such speeds must meet unprecedented demands for accuracy.

For their advanced armament control systems—the "electronic brains" of all types of Air Force interceptor airplanes, both American and Canadian, now guarding the North American continent from attack—as well as for use in the Falcon air-to-air guided missile, Hughes Aircraft Company manufactures up to 15,000 precision fine pitch gears per month. Tolerances are as close as 0.0005" total composite error, tooth-to-tooth composite error not in excess of 0.0003". Yet *standard* Fellows Gear Production and Inspection Equipment does the job.



Fellows No. 4 Fine Pitch Red Liner records tooth-to-tooth and total composite errors on permanent graph for Hughes production control.

In use at Hughes are Fellows 3" Fine Pitch Gear Shapers and Fellows No. 4 Gear Shavers for production. Inspection instruments are Fellows No. 4 Fine-Pitch Red Liner instruments and No. 12M Involute Measuring instruments.

To combine extreme accuracy with high production rates, look to the complete line of Fellows gear production equipment. Write, wire, or phone your Fellows Representative at any Fellows Office.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont

Branch Offices:
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Fellows *Gear Production Equipment*

For more information fill in page number on Inquiry Card, on page 259

The Finest Machine Tools for Aircraft Plants

ARE BUILT BY CINCINNATI MILLING

Die cavities in 100-ton die blocks for aircraft forgings are automatically tracer milled on this CINCINNATI Traveling Column Hydro-Tel Milling Machine. Equipment includes two independent cutting heads for machining the upper and lower halves of a die set simultaneously. Capacity: maximum size of die block, 12 feet x 30 feet, weight up to 100 tons. Vertical range of each spindle, 10 feet; longitudinal range of machine, 28 feet.

Tomorrow's sleek new aircraft depend upon advanced thinking and engineering for machine tools *today*. These ingredients of progress are a Cincinnati Milling heritage. And they are evident in many CINCINNATIS now operating at peak performance in aircraft plants throughout the country. Cincinnati Milling has the engineering personnel, experience and facilities to build additional machine tools like them, or others completely different . . . operator controlled or automated to any degree desired.

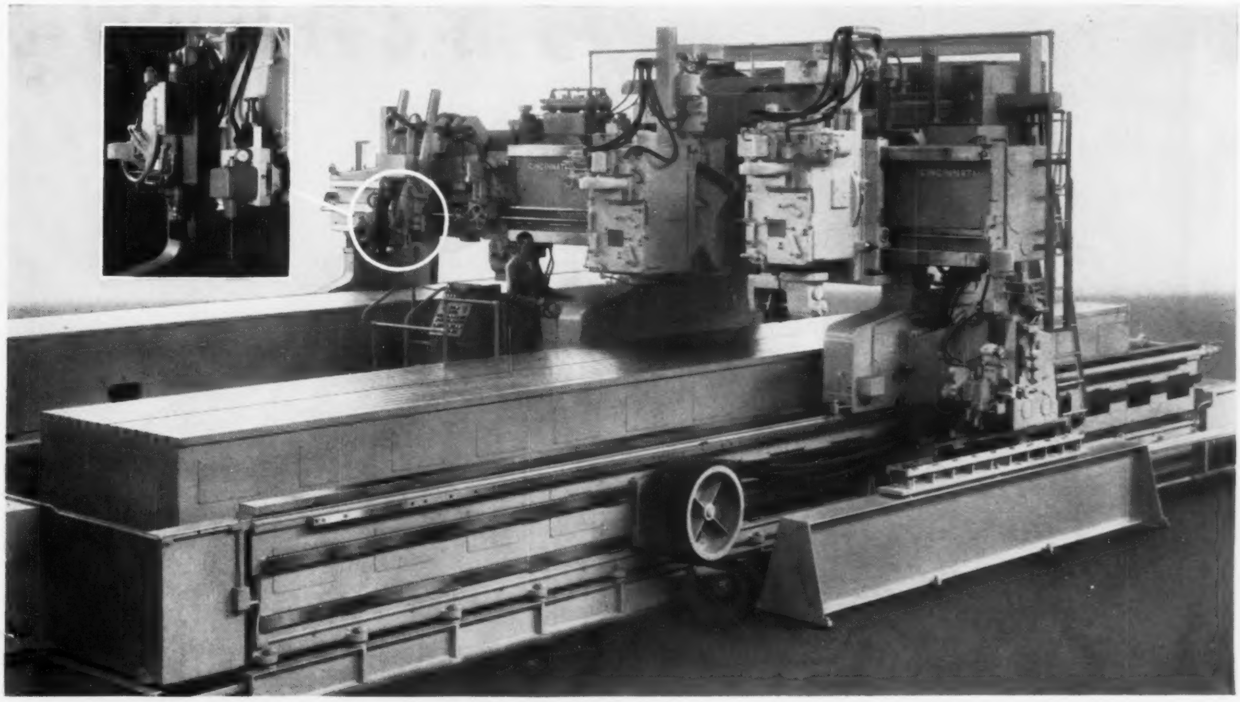
Two large CINCINNATI® Milling Machines, built to specifications for prominent aircraft companies, are illustrated here. Many others have been built for producing jet engine parts, wing sections, landing gear and similar components. May we tell you more about our ability to produce machine tools for your present and future requirements? Our engineers will be glad to work with you.

Special Machine Tool Division

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO

CINCINNATI

CINCINNATI



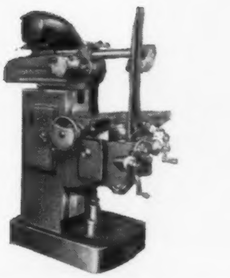
Versatility and productive capacity rate equally high in this CINCINNATI Aircraft Milling Machine. Some of the operations performed by the machine include horizontal and vertical spindle cuts in aluminum, steel or titanium skins; twist milling; line tracing from a drawing; 360° tracing; depth tracing. For "twist" milling operations, the left-hand head swivels 30° right and left while taking a contour cut. Feeds and speeds may be selected to suit the job. Working surface—6 feet x 28 feet; template table—5 feet x 28 feet.

MILLING MACHINES • BROACHING MACHINES • CUTTER AND TOOL GRINDERS • METAL FORMING MACHINES
HARDENING MACHINES • OPTICAL PROJECTION PROFILE GRINDERS • CUTTING FLUID • GRINDING WHEELS

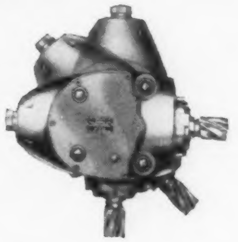
For more information fill in page number on Inquiry Card, on page 259

ONE will do...
when it's a VAN NORMAN
Ram type miller

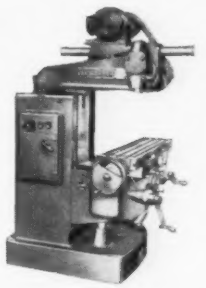
A single investment in ONE Van Norman ram type miller gives you the equivalent of two single purpose machines plus attachments. And at a much lower cost.



No. 16M — a heavy duty miller designed for maximum rigidity and accuracy. Table: 40½" x 10"; Ram Travel: 20½"; 3 HP Cutterhead Spindle Motor; Speeds: 50 to 2000.



This adjustable cutterhead, on the Van Norman 16L & 16M, gives you two millers in one. It enables you to do horizontal, angular or vertical milling, minimizes work reset-ups, cuts idle machine time and tooling costs.



No. 16L — designed to increase production and cut costs in toolrooms, machine shops, pattern shops and on production lines. Table: 40½" x 10"; Ram Travel: 20½"; Cutterhead Motor: 2 HP; Speeds 84 to 2760.

Get complete details on the Van Norman 16S, 16L, and 16M today. Write, wire or telephone for catalog.

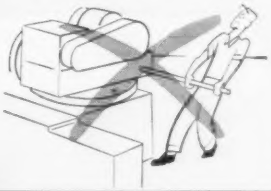
COMPANY
SPRINGFIELD 7, MASSACHUSETTS

Don't wait . . . for extra profit install a Van Norman machine now! They are available on several purchase plans . . . Outright sale . . . On conditional sales contract up to five years . . . Pay as you depreciate up to 10 years. Conditional Sales Contracts not available to Export.

For more information fill in page number on Inquiry Card, on page 259

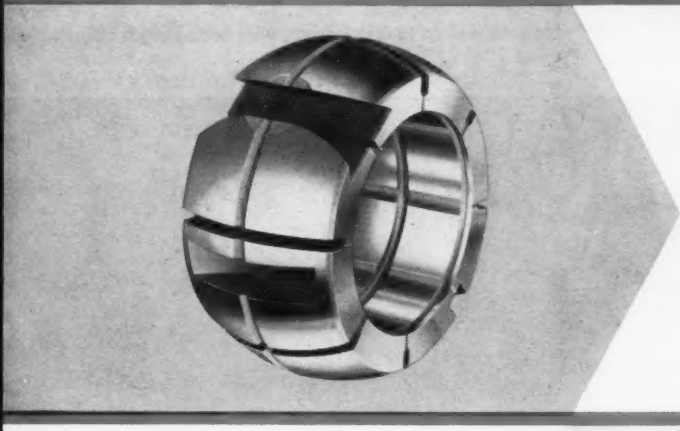
Fully universal wheelhead for fast setup

Easy hand swiveling with exclusive Landis wheelhead swivel mechanism.



Swinging internal grinding fixture for fast *change* of setup

Quickly lowers for internal grinding; locks securely and rigidly; swings up out of the way; no exposed belts.



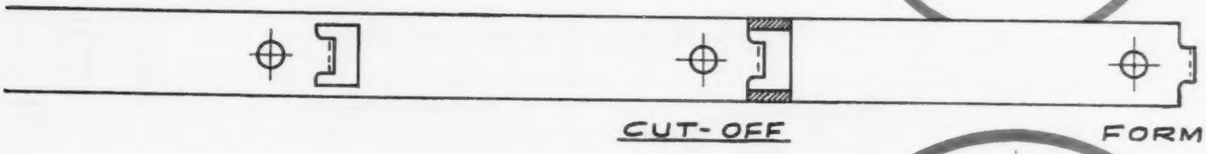
Microsphere bearings for close tolerances and fine finishes

Closest running clearance of any spindle bearing; gives sensitive response to wheel feed, quick sparkout, dependable operation.

Fully universal headstock for ease of operation

Compact, low design; only two revolving parts. Variable speed control by rheostat. Swivels for angle or face grinding.

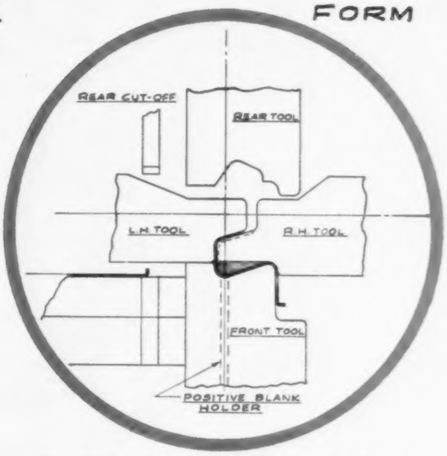
Formed metal stamping produced complete on the U. S. Multi-Slide. Drawings below indicate the progressive operations in the dies and forming position.



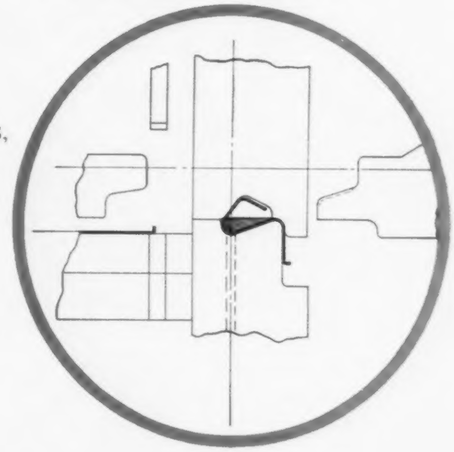
If you produce formed metal stampings, the U. S. Multi-Slide may be the answer to your cost reduction problems. The part illustrated is just one of the many different types of stampings that can be produced complete on the U. S. Multi-Slide—without secondary handlings. The combination of ram action, four-slide forming, vertical stripper, and various auxiliary units allows for the designing of tools to produce intricate parts complete—without the need for secondary operations . . . and every such operation that can be eliminated increases your profit potential.

Since these movements are an integral part of the machine equipment, it is not necessary to build complicated movements into the dies themselves, thereby giving the added advantage of reduced tool maintenance cost.

Investigate! Ask for a copy of Bulletin 15-A, or send us samples or drawings of your parts for our recommendations.



Operations in the forming position: Above: front, right-hand and left-hand tools entered to preform part around post. Below: right-hand and left-hand tools retracted; front and rear tools entered to complete the form.



U. S. TOOL COMPANY, Inc.

AMPERE (East Orange) **NEW JERSEY**

Builders of U. S. Multi-Slides — U. S. Multi-Millers — U. S. Die Sets and Accessories — U. S. Automatic Press Room Equipment

REDUCE COSTS

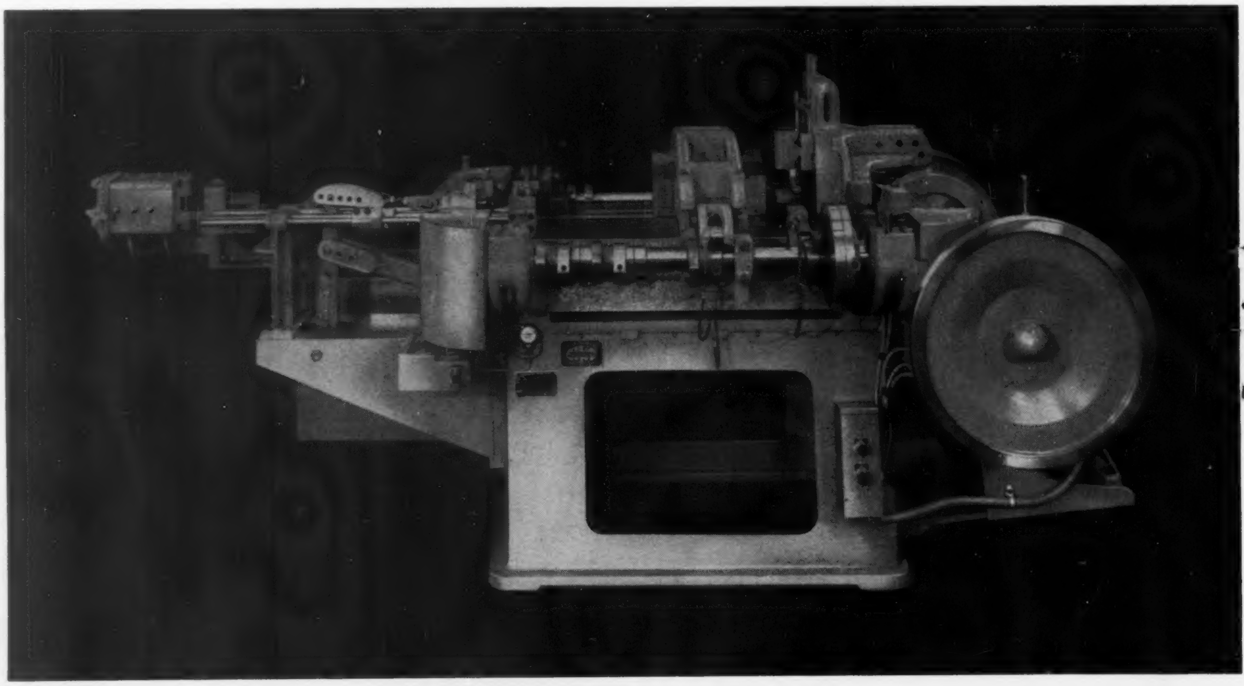
ON

FORMED STAMPINGS

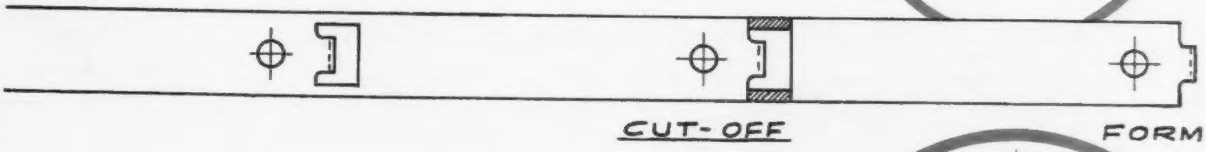
WITH

U. S. MULTI-SLIDES®

Below: The No. 33 U. S. Multi-Slide used with appropriate tooling to produce the formed metal stamping illustrated on the opposite page. The No. 33 Multi-Slide has a capacity for material up to 2½" wide, with feed length adjustable up to 12½".



Formed metal stamping produced complete on the U. S. Multi-Slide. Drawings below indicate the progressive operations in the dies and forming position.



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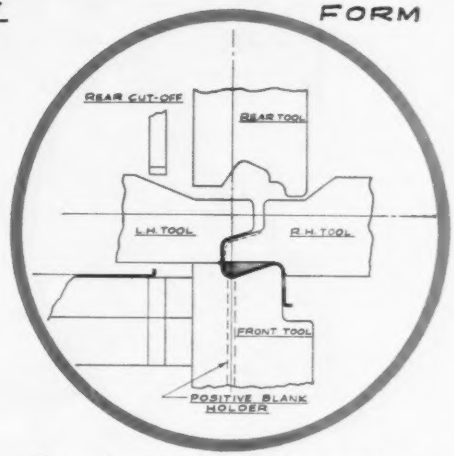

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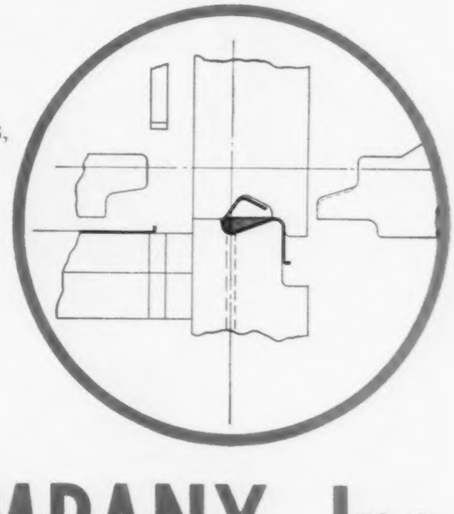


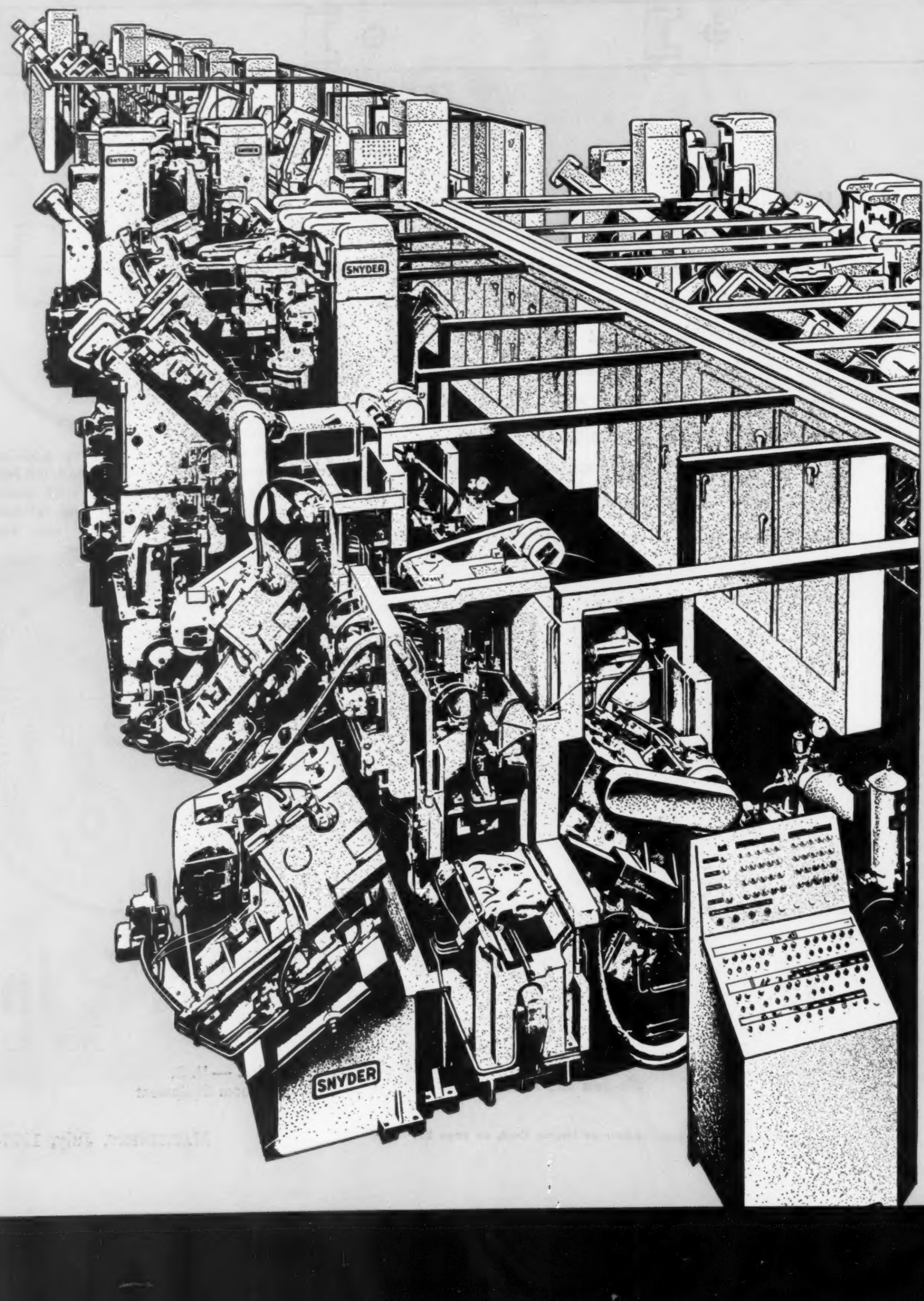
U. S. TOOL COMPANY, Inc.

AMPERE (East Orange) NEW JERSEY

Builders of U. S. Multi-Slides — U. S. Multi-Millers — U. S. Die Sets and Accessories — U. S. Automatic Press Room Equipment

For more information fill in page number on Inquiry Card, on page 259

Unique Combination of Snyder Special Two or Four Barrel Intake Manifold

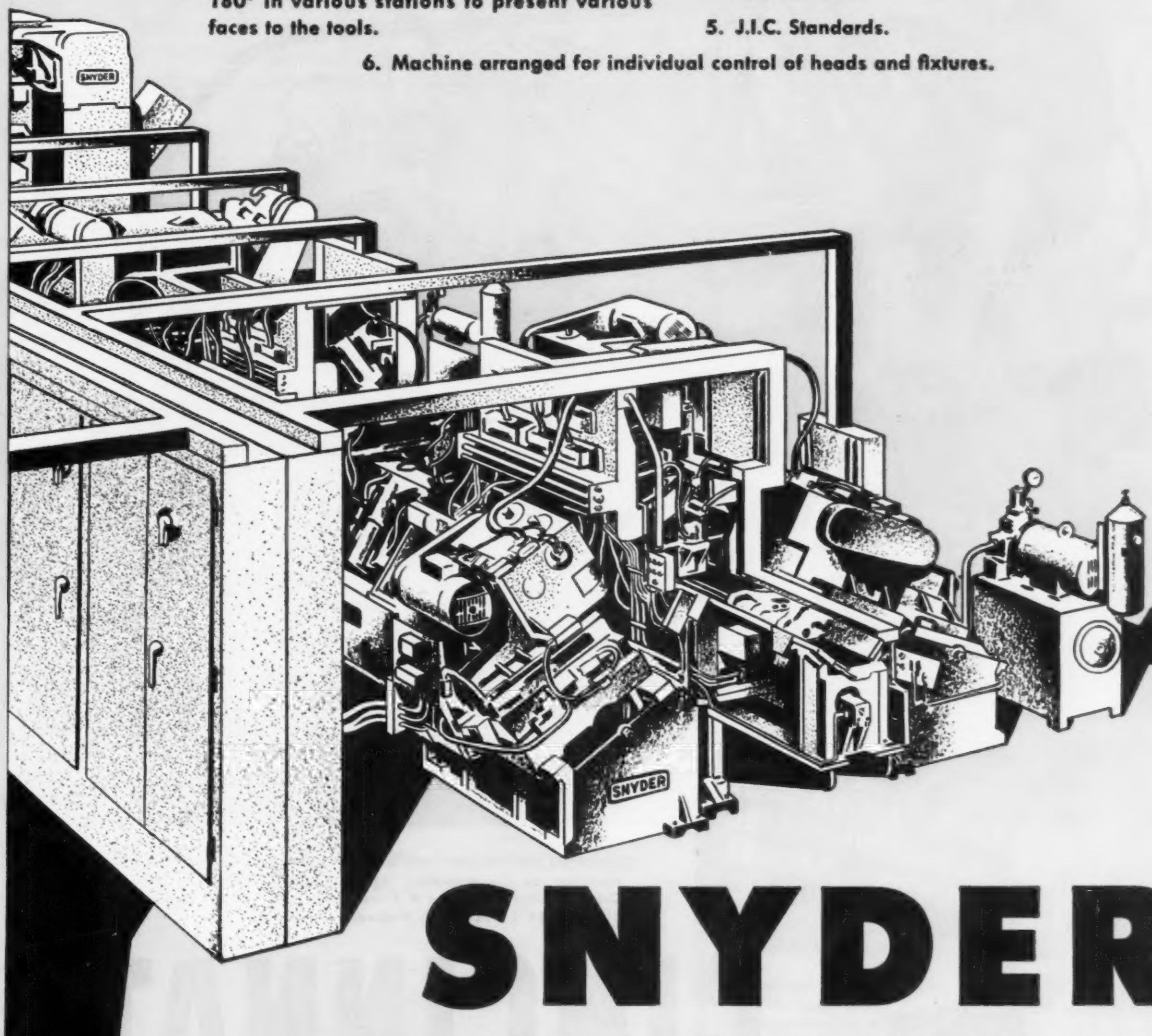


Transfer Machines Processes Either Castings from Rough to Finished Parts

Combination of two special transfer milling machines in parallel, with automation, feeding into one special transfer drilling machine gives production of 136 pieces per hour

Special Features of Snyder Machines Nos. 55-60 and 55-61

1. Machine line handles two or four barrel manifolds, random intermixed; sensing devices automatically instruct the proper drilling and tapping units.
2. Part rotated vertically 180° and horizontally 180° in various stations to present various faces to the tools.
3. Individual electrical panels and hydraulic units for each segment.
4. Wing bases, sections, spacers and risers standard throughout for easy adaptation to future part changes.
5. J.I.C. Standards.
6. Machine arranged for individual control of heads and fixtures.



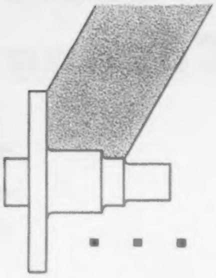
SNYDER

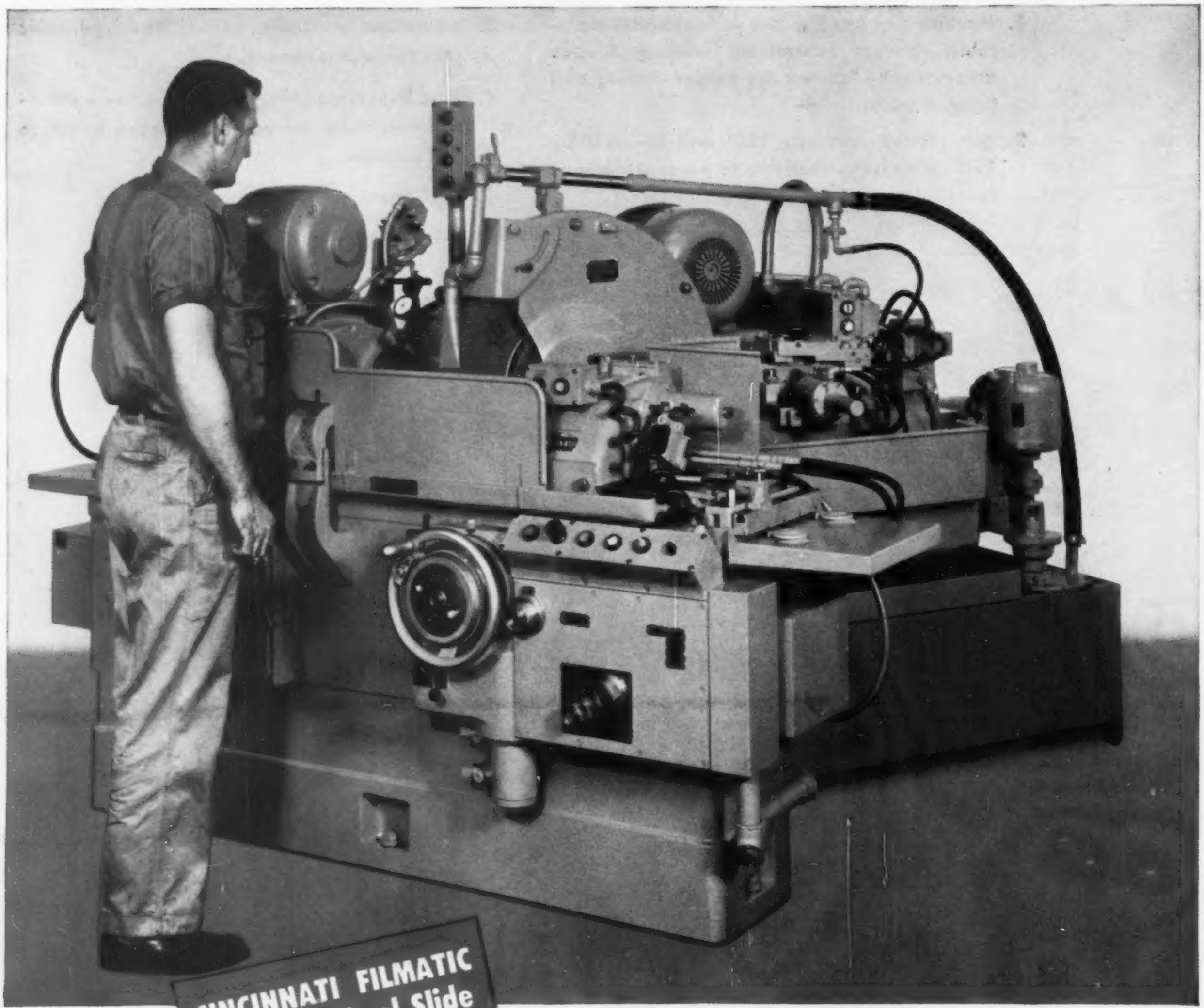
TOOL & ENGINEERING COMPANY

3400 E. LAFAYETTE • DETROIT 7, MICHIGAN

32 Years of Special Machine Tools with Automation

It Pays to Combine





CINCINNATI FILMATIC
Angular Wheel Slide
GRINDING MACHINE

Diameters and adjacent radii and shoulders are precision ground in one operation on this CINCINNATI FILMATIC 10"R x 18" Angular Wheel Slide Grinder. Sizes available: 6"R and 10"L x 18" or 30" between centers; 10"R and 14"L x 18" to 72" between centers.

CINCINNATI

CENTERTYPE GRINDING MACHINES • CENTERLESS GRINDING MACHINES • ROLL GRINDING MACHINES • SURFACE

Precision Grinding Operations

Especially on a CINCINNATI Built for the Job

Time, effort and dollars are saved when operations are combined. And quite often quality improves, just as it does when diameters and adjacent radii and shoulders are ground in one operation on CINCINNATI® FILMATIC Angular Wheel Slide Grinding Machines. These fine precision grinders are built for high production work at the lowest cost of any equipment available today. Many features contribute to this outstanding performance. Four are illustrated at the right. Others include:

Push-button automatic grinding cycle, incorporating coarse and fine feed rates for maximum production and high-quality finish.

Roll-out cutting fluid tank. Cuts down service attention.

***Automatic air-electric gage sizing** with cycle time stabilizer. High degree of accuracy and compensation for wheel wear obtained automatically.

***Automatic gap eliminator.** A timesaver where stock allowance varies widely.

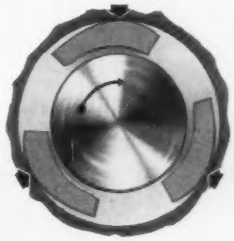
***Behind-the-wheel profile truing equipment,** for automatic, accurate profile truing in both directions.

Additional features and their advantages are illustrated and described in catalog No. G-686. Everyone concerned with modern precision grinding methods and low costs should have a copy. May we hear from you? Meanwhile you might want to look at the brief specifications in Sweet's.

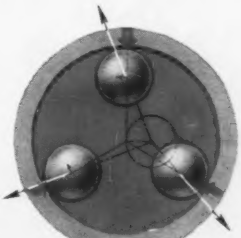
**Available at extra cost.*

CINCINNATI GRINDERS INCORPORATED
CINCINNATI 9, OHIO

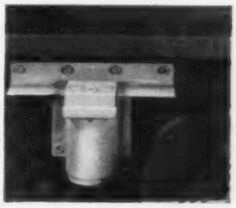
FILMATIC



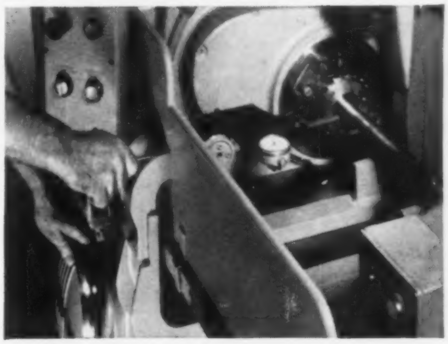
FILMATIC grinding wheel spindle bearings, exclusively CINCINNATI, have never been equalled by any other spindle bearing mounting.



Automatic grinding wheel balancing, an exclusive CINCINNATI feature, balances the wheel and mount within a few seconds.



Automatic hydraulic table clamp automatically locks the machine table in position during the grinding cycle.



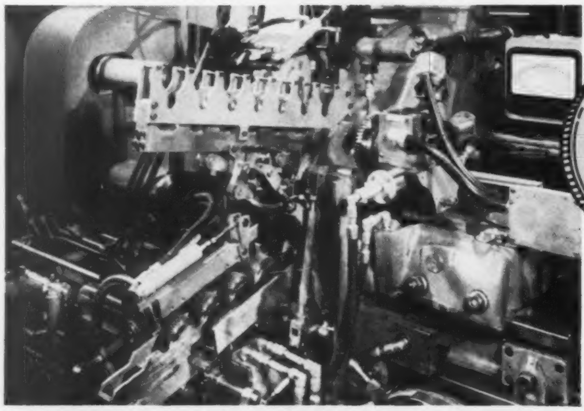
Manual flagging device, for locating the work axially with respect to the wheels, is simple and accurate. Automatic flagging device is also available.

GRINDING MACHINES • CHUCKING GRINDERS • MICRO-CENTRIC GRINDING MACHINES • CENTERLESS LAPPING MACHINES

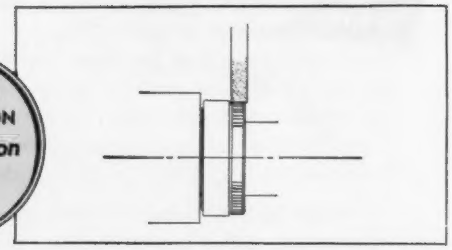
For more information fill in page number on Inquiry Card, on page 259

The more you grind the more you save with Norton...

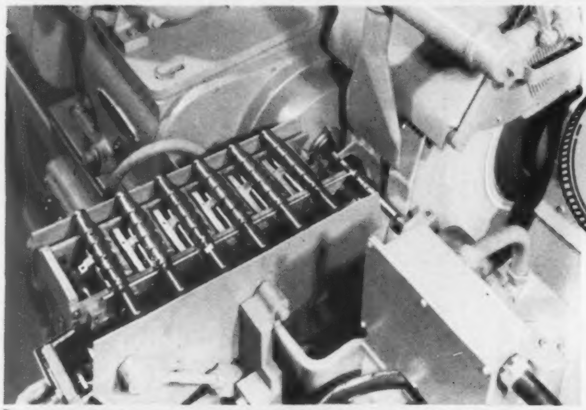
Typical automatic features on Norton grinders



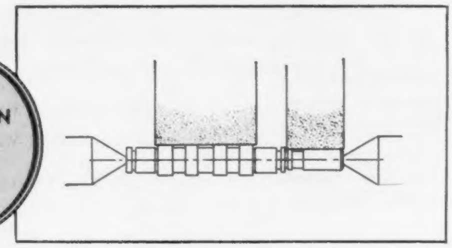
SAVINGS ON *Transmission Gears*



In a Type CTU Cylindrical Grinder arranged for completely automatic loading, grinding, and unloading of transmission gears, the part is held on a chuck and grinding cycle is terminated by an automatic air-electric grinding gage that signals when work is to size.

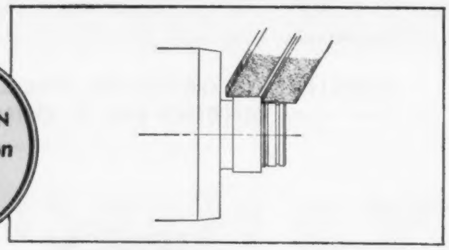


SAVINGS ON *Valve Pistons*

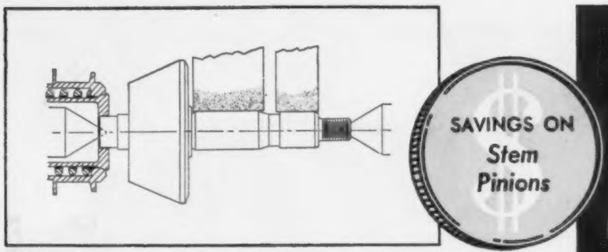


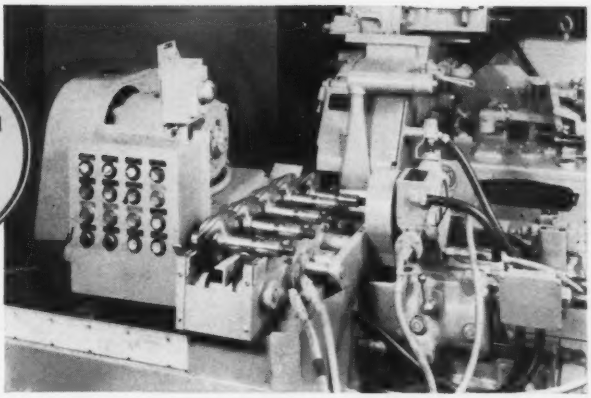
When a Type CTU Grinder is arranged for fully automatic loading and grinding of valve pistons the part is held on centers and driven by a floating type collet. Work is ground by a double-wheel mount.

SAVINGS ON *Transmission Sleeves*



On this Type CV-4 Angular Wheelslide Grinder chucked grinding of transmission sleeves is arranged in a completely automatic cycle. Longitudinal movement of a revolving turret loads the machine. A stripper type plate removes the piece when turret retracts as the grind is terminated by electrically timed control.





The Stem Pinion Grinder reduces time and effort with a completely automatic cycle, electrically timed arrangement for grinding these hard-to-handle parts. Progressive escapements in the automatic loading mechanism release the parts in succession, avoiding gear mesh.

NEW ECONOMY!

Norton No. 2 Unitized Transfer Grinder Grinds Crankpins Automatically

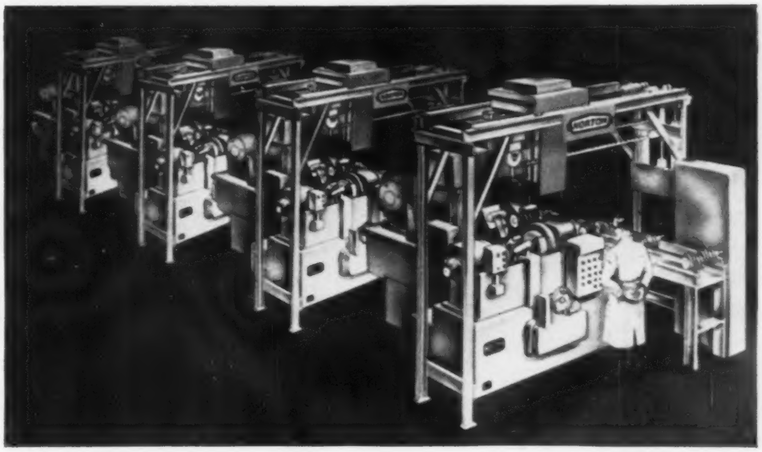
Here's a newly developed machine that automatically grinds crankpins faster and for less money than ever before possible. Advanced features like the following are reasons why:

Unitized Operation. Each grinding station, operating independently, can be automatically by-passed without affecting continuous production.

New Transfer Mechanism. Double set of hooks speeds loading, unloading and transferring of crankshafts from one grinding unit to another.

Fast Production. Cycling grinds 240 crankpins on 60 V-8 crankshafts per hour, due to many automatic operations.

Only One Operator Needed. Others are freed for different jobs. And the machine reduces floor-space requirements.



Norton has developed a wide range of fast, automatic grinders. You can get them in conventional and angular wheelslide types — also in special types for grinding automotive valve faces and crankshaft pins.

Remember: only Norton offers you such long experience in both grinding machines and wheels to bring you the "Touch of Gold" that helps you produce more at lower cost.

For further information about these machines — including how the No. 2 Unitized Transfer Crankpin Grinder can save you many dollars daily — contact your Norton Representative. Or write to NORTON COMPANY, Machine Division, Worcester 6, Mass.

District Offices:
Worcester • Hartford • Cleveland • Chicago • Detroit

To Economize, Modernize with NEW

NORTON

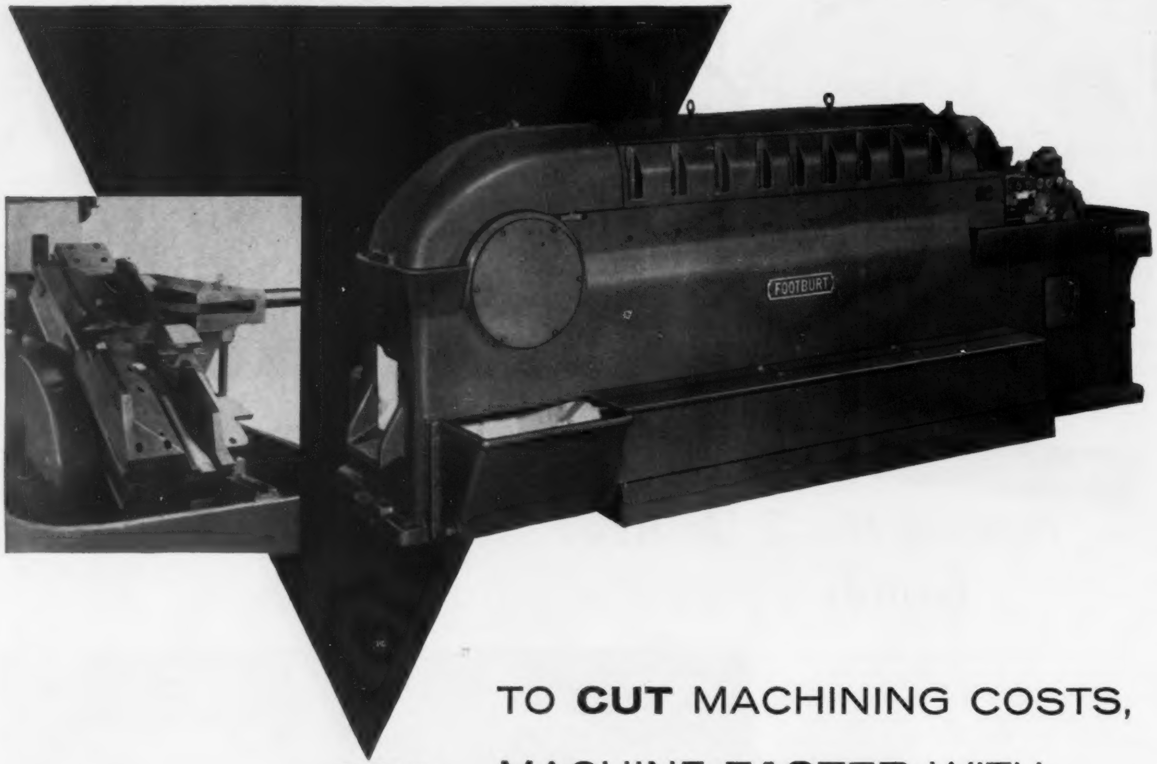
GRINDERS and LAPPERS

Making better products... to make your products better

NORTON PRODUCTS:
Abrasives • Grinding Wheels • Grinding Machines • Refractories

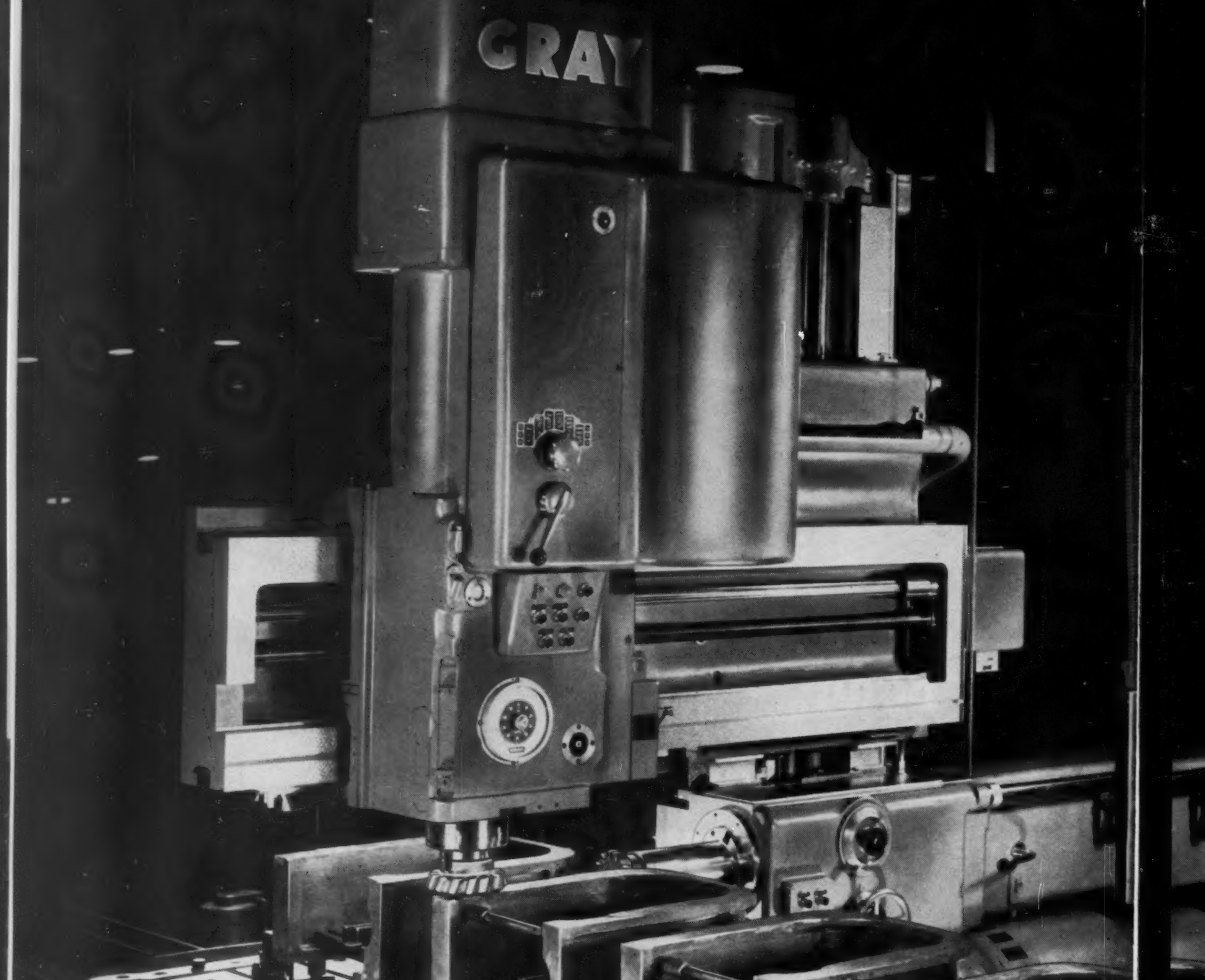
BEHR-MANNING DIVISION:
Coated Abrasives • Sharpening Stones • Behr-cat Tapes

For more information fill in page number on Inquiry Card, on page 259

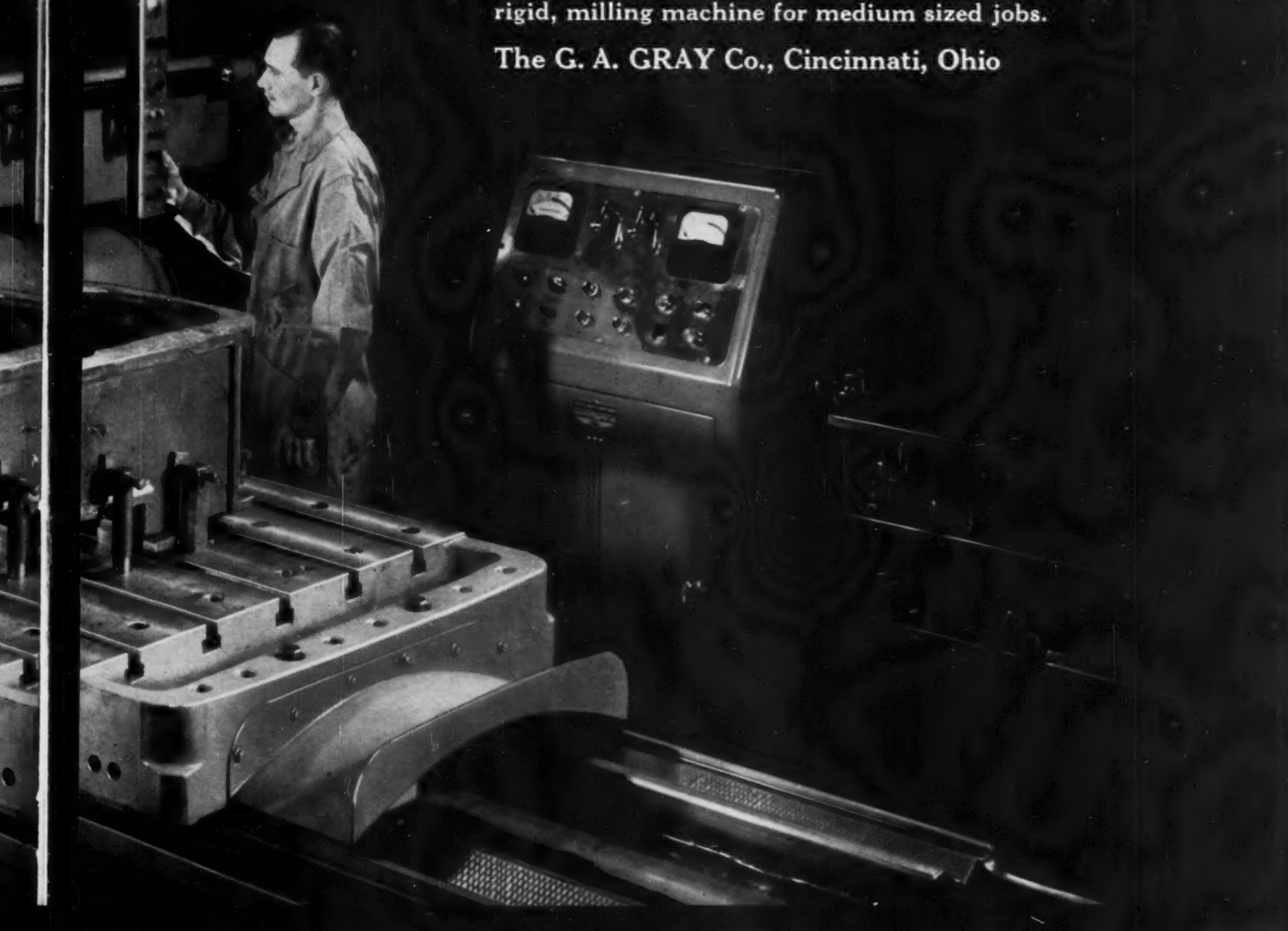


For more information fill in page number on Inquiry Card, on page 259


new
GARDNER
BH
bond



what's the DIFFERENCE...



what's the DIFFERENCE . . .

the DIFFERENCE is . . .

To you, the user or buyer, the most important difference between MARVEL High-Speed-Edge Hack Saw Blades and ordinary blades is the *unequalled* performance you get from MARVEL Blades.

Performance reflected in higher production (faster cutting-off), greater accuracy of cut-off blanks, and longer blade life has made MARVEL the preferred blade in every kind of metal sawing operation.

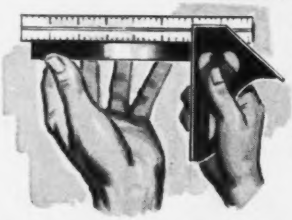
To get the *difference* in performance, always insist on MARVEL High-Speed-Edge Hack Saw Blades. Leading Industrial Distributors have them in stock.

Write for "The MARVEL Story." It has complete details on MARVEL High-Speed-Edge Hack Saw Blades and Hole Saws.

HIGHER PRODUCTION

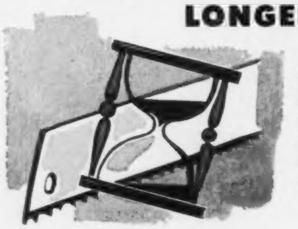
Unbreakable MARVEL High-Speed-Edge Blades can be worked faster and harder than any other blade with complete safety. They will withstand the highest speeds and heaviest feeds attainable on any make hack sawing machine. MARVEL Blades will cut any machineable metal. No wasted time changing blades for different materials.

GREATER ACCURACY



Composite construction permits MARVEL Blades to be tensioned from 200% to 300% more taut than ordinary blades. This produces greater rigidity of the high-speed-steel cutting edge, resulting in maximum obtainable accuracy of cut-off blanks.

LONGER BLADE LIFE



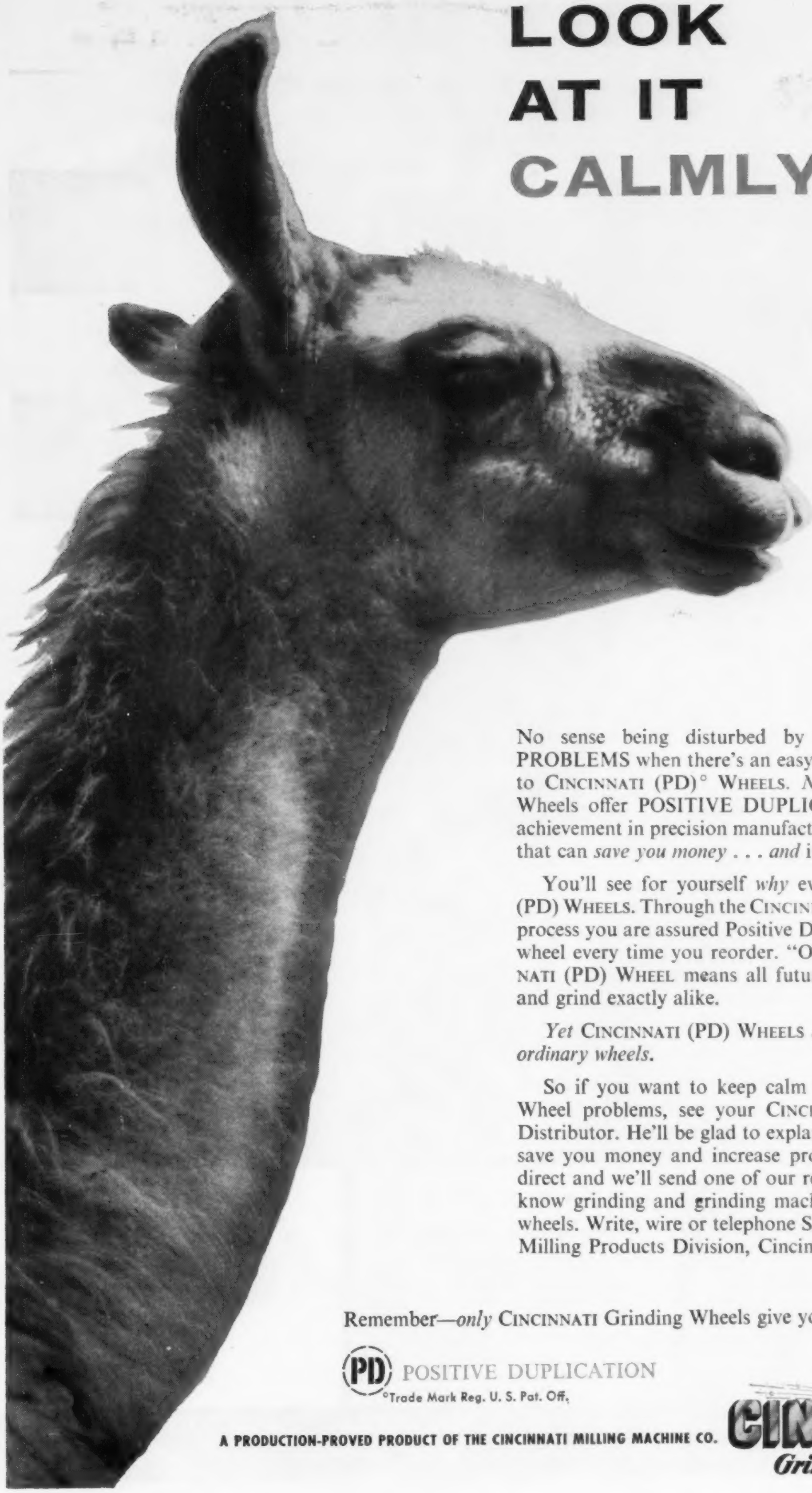
Each MARVEL High-Speed-Edge Hack Saw Blade is triple tempered to assure maximum toughness of the cutting edge. MARVEL Blades not only give you longer life, they assure a *more efficient* cutting life, with resulting lower blade costs.

B-1121

ARMSTRONG-BLUM
MFG. CO.
5700 WEST BLOOMINGDALE AVE. • CHICAGO 39, ILL.

MARVEL Metal Cutting SAWS
Better Machines—Better Blades

LOOK AT IT CALMLY



No sense being disturbed by GRINDING WHEEL PROBLEMS when there's an easy solution in sight. Switch to CINCINNATI (PD)° WHEELS. *Now* Cincinnati Grinding Wheels offer POSITIVE DUPLICATION—a remarkable achievement in precision manufacturing and quality control that can *save you money . . . and* increase your production.

You'll see for yourself *why* everybody's talking about (PD) WHEELS. Through the CINCINNATI (PD) Manufacturing process you are assured Positive Duplication of the original wheel every time you reorder. "On grade" with a CINCINNATI (PD) WHEEL means all future (PD) WHEELS will act and grind exactly alike.

Yet CINCINNATI (PD) WHEELS *are priced no higher than ordinary wheels.*

So if you want to keep calm in the face of Grinding Wheel problems, see your CINCINNATI Grinding Wheels Distributor. He'll be glad to explain how (PD) WHEELS can save you money and increase production. Or, contact us direct and we'll send one of our representatives—men who know grinding and grinding machines as well as grinding wheels. Write, wire or telephone Sales Manager, Cincinnati Milling Products Division, Cincinnati 9, Ohio.

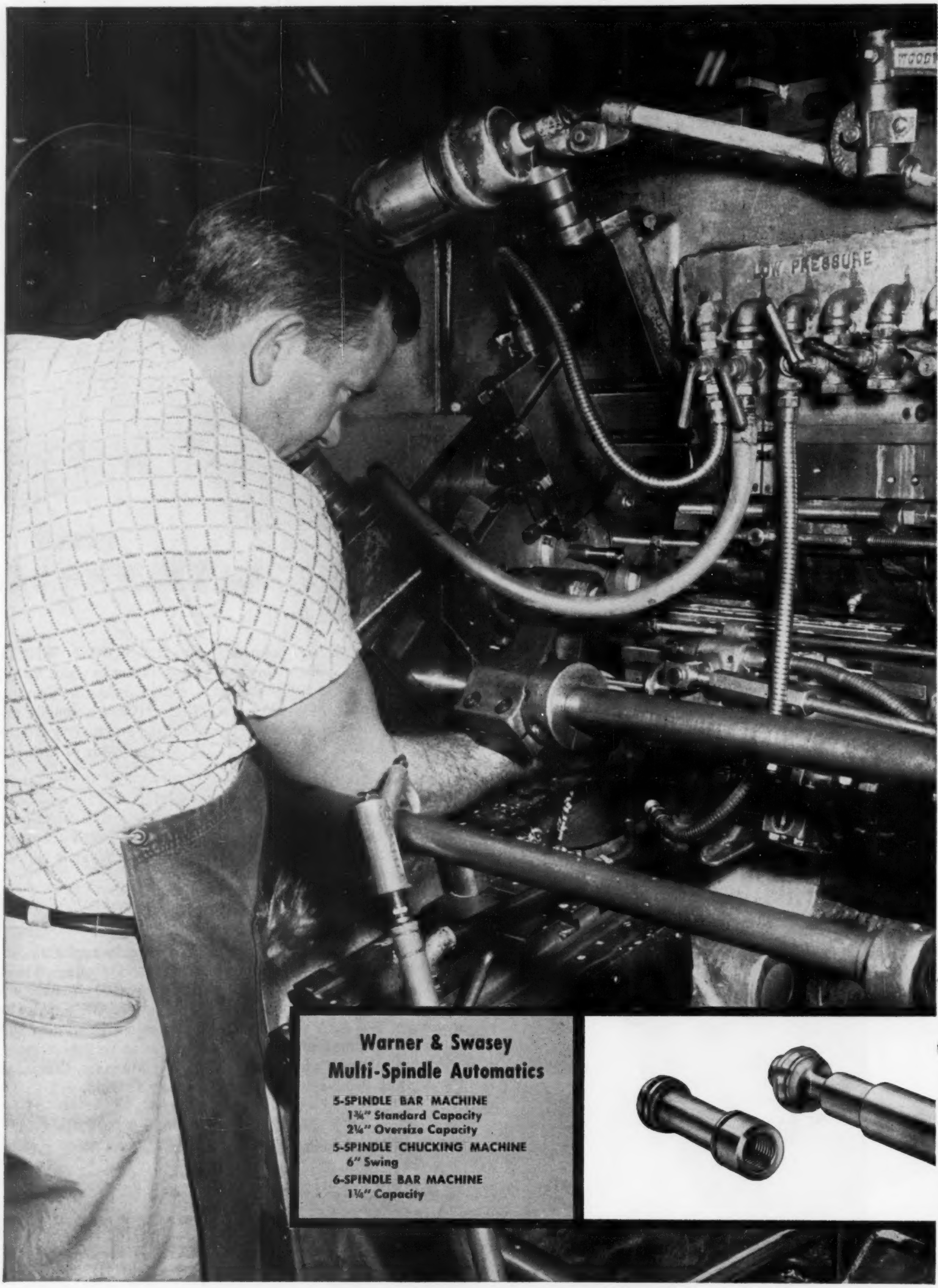
Remember—*only* CINCINNATI Grinding Wheels give you

(PD) POSITIVE DUPLICATION
°Trade Mark Reg. U. S. Pat. Off.

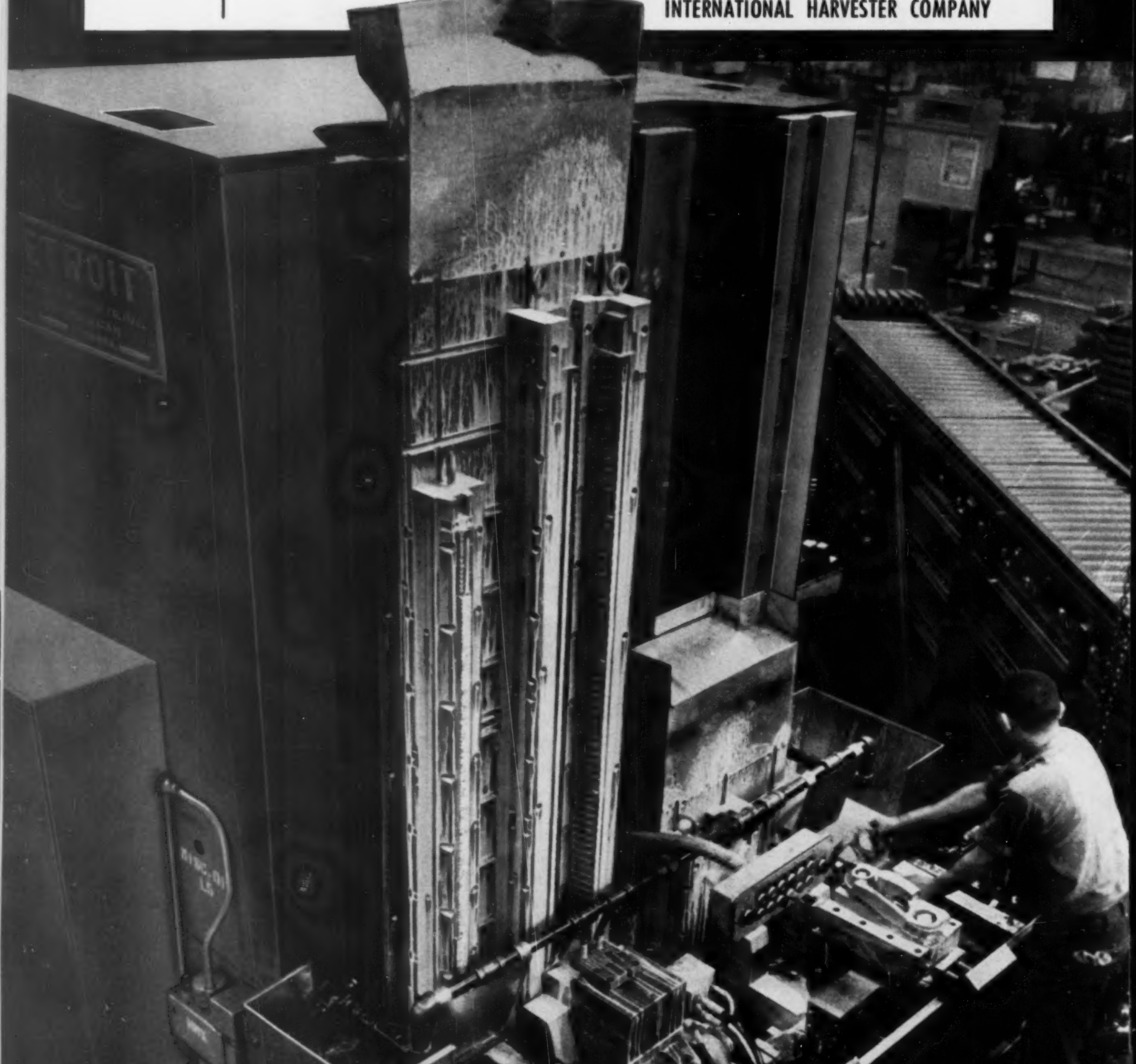
A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

CINCINNATI°
Grinding Wheels

For more information fill in page number on Inquiry Card, on page 259



Warner & Swasey
Multi-Spindle Automatics
5-SPINDLE BAR MACHINE
1¾" Standard Capacity
2¼" Oversize Capacity
5-SPINDLE CHUCKING MACHINE
6" Swing
6-SPINDLE BAR MACHINE
1¼" Capacity



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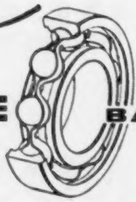
FACTS

about

NEW DEPARTURE BALL BEARINGS



NOW A [NEW] DEPARTURE IN PILLOW BLOCKS

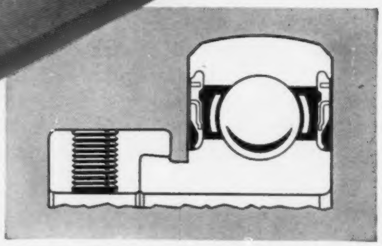
- Clean, rigid, compact design.
- Free of any lubricating fixtures.
- New Departure ball bearings sealed and lubricated-for-life.
- Pillow Blocks easily mounted without special tools.
- Only high capacity precision ball bearings used.
- Accommodates any misalignment.
- 31 shaft sizes, ½″ through 2$\frac{7}{16}$″.
- Interchangeable with most makes.

Send for Catalog PBC for complete details.

GREASE SEALED IN
DIRT SEALED OUT
with
FAMOUS SENTRI-SEAL

ON GUARD AGAINST DIRT

New Departure Pillow Blocks employ the performance-proved New Departure Type AE Adapter ball bearings with spherical O.D. for alignability and steel-reinforced Sentri-Seals for long life protection against dirt or grease leakage.



The bearings are easily applied to the shafting and are positively locked in position with an eccentric cam locking collar and set screw.

BALL BEARINGS MAKE GOOD PRODUCTS BETTER

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONN.

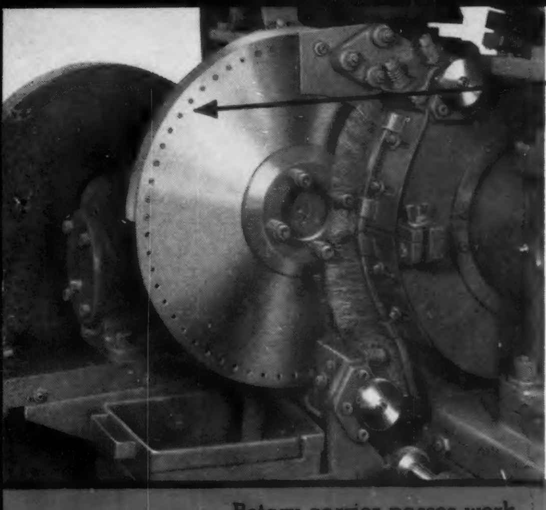
For more information fill in page number on Inquiry Card, on page 259

The accuracy and finish of small bearing races ground on this Gardner 77A-12" double spindle grinder save the cost of a former lapping operation.

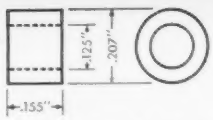
grinds TWO parallel surfaces in ONE operation

Gardner grinder cuts costs

close tolerances and quality finish eliminate lapping operation



Rotary carrier passes work between abrasive discs



production data

Part:	Small inner bearing race
Operation:	grinding parallel sides
Production:	2500 parts per hour
Stock removal:	.006" to .008"
Tolerances:	.0001" parallelism
	.0005" uniformity
	.0001" squareness

GARDNER

precision disc grinders

BELOIT, WISCONSIN

For more information fill in page number on Inquiry Card, on page 259

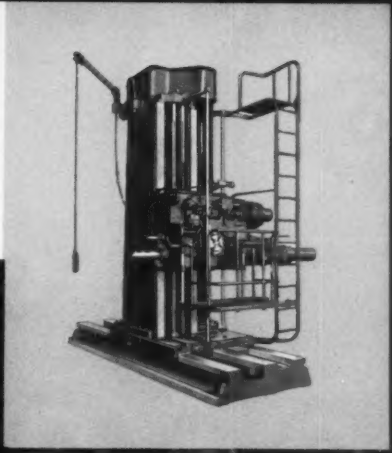
HOW IT'S DONE
with *Giddings & Lewis*

You're looking at a production line which consists of fifteen Cincinnati Bickford Super Service Radials (with 3′ to 6′ arms) that speed manufacturing operations of a leading earthmoving equipment line. Radials handle all boring, drilling, reaming, tapping and facing operations on rear axle housings, differential carriers, cylinder hoists, and other components for 7 to 25-yd. scrapers, rear-dump and bottom dump haulers, etc.

Here's a good yardstick for measuring production methods

Compare your own operations with these performance stories done on Giddings & Lewis machines . . .

At De Luxe Die Works this G&L Model 360-F (floor-type) Horizontal rough and finish-mills 13 large wear plate areas and 4 small keeper pads in upper die shoe with 8" dia. face mill. The 8½-ton die forms the left rear fender of a 1958 model car.



G&L **dependability** demonstrated at De Luxe! precision machining fender dies...

Five G&L Horizontals work two shifts daily producing both large and small dies

"These G&L's are busy 18 and 20 hours a day," remarks Richard L. Dahl, shop superintendent at De Luxe Die Works, East Detroit, Michigan.

One of the largest automotive tool and die builders in the country, De Luxe precision-machines large and small dies on Giddings & Lewis Horizontal boring, drilling and milling machines. Dies are used in production of automobile quarter panels, hoods, deck lids, front and rear fenders.

The 8½-ton cast iron shoe (illustrated above) requires approximately 50 hours machining time on a G&L Model 360-F (floor-type) Horizontal with 6" dia. spindle. Thirteen large wear plates are rough and finish-milled using an 8" dia. face mill with high-speed cutters. All heels and safety pads are rough and then finish-milled.

Other G&L Horizontals include: Model 350-T (table-type) and a No. 56-T (table-type) with special attachment for profiling and contour milling of air-hardened steel dies. Smaller dies are bored, drilled and milled on two Giddings & Lewis No. 45-T (5" dia. spindle) precision horizontals. One is equipped with a 52" x 108" table, the other with a 40" x 84" table.

Model 360-F Horizontal is one of 24 Giddings & Lewis floor-type machines available with main spindle diameters from 5" through 14" — motor drives from 20 through 150 hp — larger machines available with underarm spindle support.

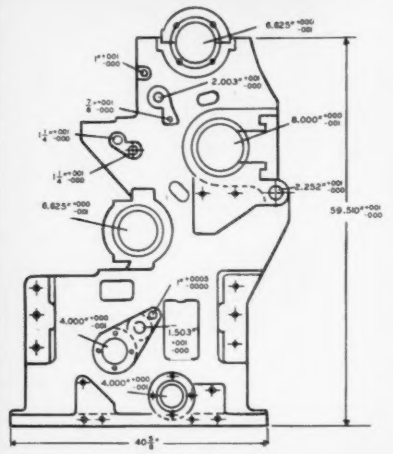
For complete specifications on the 30 Series (floor-type) Horizontal machines, see your nearest Giddings & Lewis representative, or write for Catalog No. 30-F.

G & L *and* HYPRO DIVISION
GIDDINGS & LEWIS MACHINE TOOL CO.
FOND DU LAC, WISCONSIN

Builders of the world's finest heavy-duty Horizontal Boring, Drilling and Milling Machines — table, floor and planer types; HYPRO Double Housing and Openside Planers; Planer-Type Milling Machines; Vertical Boring Mills; Spar and Skin Milling Machines and VARIAX Milling Machines.

HOW IT'S DONE

with *Giddings & Lewis*... building offset printing presses

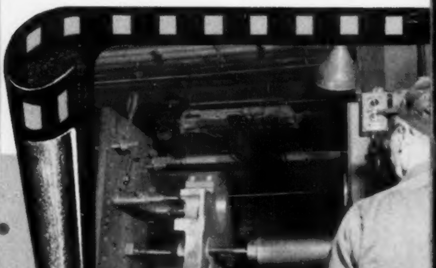


Production sequence shown in pictures

Before machining starts, main frame for the offset press is squared vertically and horizontally on the table and with centerline of the machine spindle. Machine's automatic electric positioning device maintains tolerances and distances between centerlines of various size bores.

1. Two 6.625" bores for plate and impression cylinders—rough, semi-finish and finish-bored to .001" tolerance. Davis boring bar (4" dia., 10" long) and two-cutter blocks with expandable cutters used for rough boring at 102 rpm, .025 ipr feed.

2. The 8.000" bore for blanket cylinder—rough, semi-finish and finish-bored . . . also back-faced with a Davis 11.125" facing cutter. Rough boring is with a Davis block-type cutter at 89 rpm, .025 ipr feed.



3. This 2.003" hole is drilled first with a 1" drill and then with a 1⅞" drill before it is rough, semi-finish and finish-bored. Rough boring is accomplished with a Davis block type cutter at 329 rpm, .025 ipr feed.

Unwavering precision

...key reason why Harris-Seybold's Cleveland Division makes wide use of Davis standard tools on precision bearing operations

High product quality has made Harris-Seybold, Cleveland, a recognized leader among makers of offset lithographic presses. Use of Davis boring bars and cutting tools at the company's Cleveland Division, where the largest presses are made, is in keeping with this reputation.

Davis block-type general purpose boring bars with interchangeable cutter blocks are used for *virtually all* precision boring operations on press main frames. Machinists report Davis block type cutters last longer, require far less frequent sharpening. They're pleased, too, with the fact that Davis carbide cutting tools are ideal for high speeds and feeds.

Shown at left is the machine on which these standard Davis boring tools demonstrate unwavering precision. It's a Giddings & Lewis Model 350-T (table-type) Horizontal with 5" spindle, 60" x 96" table, 120" bed, extended saddle and saddle supports, in-the-floor type auxiliary runways. Its automatic electric positioning device ends time-consuming fine hand adjustments . . . permits automatic setting of headstock and table . . . assures accurate, repetitive machine settings to .0002"

19 Giddings & Lewis machines contribute to Harris-Seybold quality

In addition to the Model 350-T Horizontal described above, there are *five* Cincinnati Bickford 4-spindle 24" Super Service gang drills . . . *one* 24" round column upright . . . *two* 3'-11" radial (12-speed head) . . . *two* 4'-11" radial (36-speed) . . . *three* 6'-19" radials . . . *one* 5-spindle upright . . . *one* Model 330-T and 50-T Horizontal . . . *two* HYPRO planer-millers (84" x 84" x 16').

You'll find the boring tools you want in the complete Davis line. See your local Davis sales representative or write for Catalog No. 304.

DAVIS BORING TOOL DIVISION

GIDDINGS & LEWIS MACHINE TOOL CO.

FOND DU LAC, WISCONSIN

Line and Stub Boring Bars, Boring Heads, Block Type Cutters, Planing and Turning Tools, and Special Production-Engineered Job Tooling.

Choose from the complete Davis line of standard boring, turning and planing tools . . .

Davis production-engineered tooling designs . . .

Special spherical boring tool designs are typical of Davis custom tooling service. Feel free to call on us for special-design solutions to your machining problems.

4. This 1¼" hole is drilled — rough, semi-finish and finish-bored. Rough boring is with Davis block type, double-tip cutters at 375 rpm, .025 ipr feed.

5. This 2.252" hole is drilled — rough, semi-finish and finish-bored. Rough boring is with a Davis two-cutter block with expandable cutters at 329 rpm, .025 ipr feed.

6. Two 4.000" holes are finish-bored to plus .000", minus .001" with Davis two-cutter block with expandable cutters at 160 rpm, .025 ipr feed.

HOW IT'S DONE
with Giddings & Lewis

machining dies in East Detroit...

Intricate, precision die machining operations profitably handled

Giddings & Lewis Model 340-T (table-type) Horizontal pays its way with precision performance at Supreme Impression & Mold Co.

Supreme is one of America's major die-cast die producers. The company's precision-made products are used in casting magnesium, aluminum and zinc components for the automotive and appliance industries.

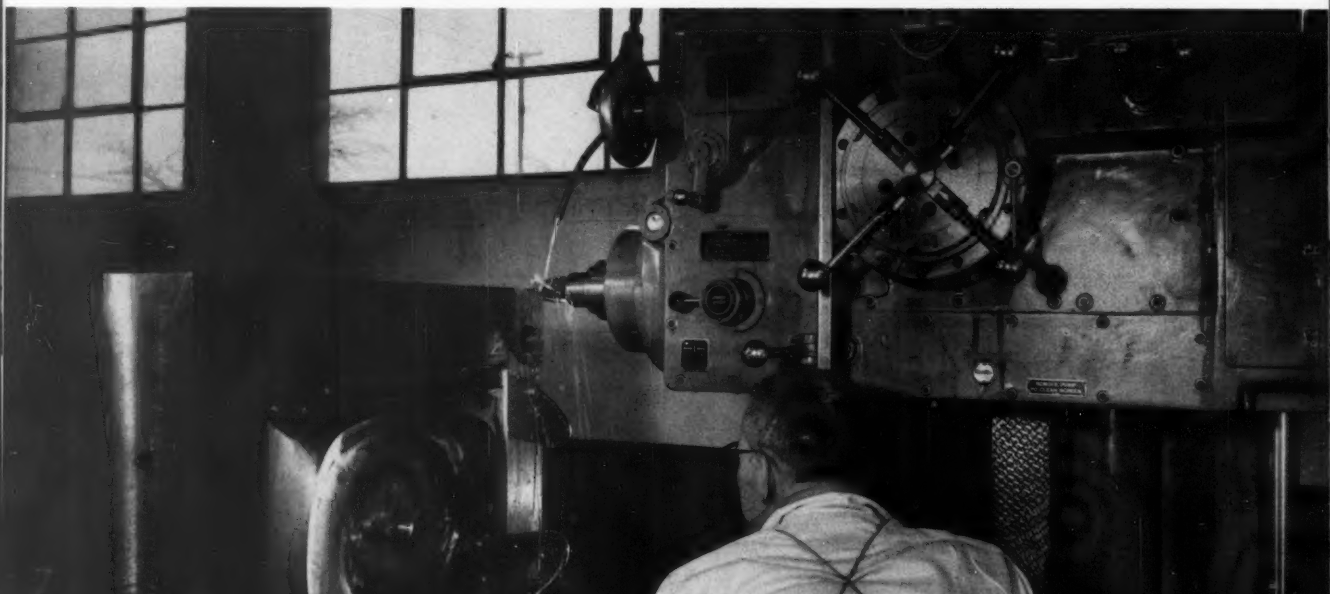
Pictured at work below is Supreme's G&L Model 340-T (table-type) Horizontal boring, drilling and milling machine — 4″ diameter spindle, with 48″ x 72″ table, 48″ column, extended saddle and saddle supports, in-the-floor auxiliary runways. Workpiece in a cover-half die to be used for casting TV-receiver screen frames. Weighing approximately 2500 lbs, the die is Crucible CSM-2, preheat treated to 280-310 Brinell. The G&L Horizontal removes more than 300 lbs. of metal in the following production operations:

1. Die edges rough and finish milled using 14″ face mill with ten high-speed cutters. Finish cuts at 20 rpm, .010″ feed per tooth.
2. Clamp slots milled and eye-bolt holes bored. Four 2½″ leader-pin holes precision drilled, bored and reamed (bushings also precision bored).
3. Ejector plate and rails are face-milled with an end mill.
4. Ten core pin holes of various sizes are precision bored.
5. The 2″ sprue pin hole is bored . . . taper-reamed on the cover-half of the die, straight-bored on the ejector half.
6. Four corners of cover-half is radius-milled with an end mill.
7. Sixteen water line holes of various sizes (30″ to 34″ deep) drilled, reamed and pipe-tapped in both cover-half and ejector half.

G & L *and* HYPRO DIVISION
GIDDINGS & LEWIS MACHINE TOOL CO.
FOND DU LAC, WISCONSIN

Builders of the world's finest heavy-duty Horizontal Boring, Drilling and Milling Machines — table, floor and planer types; HYPRO Double Housing and Openside Planers; Planer-Type Milling Machines; Vertical Boring Mills; Spar and Skin Milling Machines, and VARIAX Machines.

LITERATURE! *For complete specifications on G&L 30 Series (table-type) horizontal boring, drilling and milling machines, ask for Bulletin No. 30-T.*



All window surfaces of this huge casting are rough and finish-milled to exact tolerances on G&L's 570-T (table-type) Horizontal. Use of 90° angular milling attachment greatly reduces number of setups required . . . simplifies machining of hard-to-reach surfaces.

Extra measure of power, speed and precision

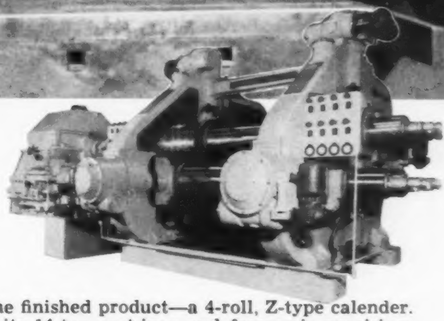
That's what makes a G&L 570-T (table-type) Horizontal one of the busiest and most productive machines at Adamson United Company

This Akron, Ohio, company is an important producer of basic and special process machinery for rubber, plastics, plywood, chemical and other industries.

Metalworking production engineers at Adamson United are enthusiastic about the performance they're getting from their Giddings & Lewis Model 570-T (table-type) Horizontal with 7" spindle. Working on both horizontal and vertical surfaces, the G&L is shown above precision-machining on a 14-ton side-frame casting of a calender.

Equipped with a G&L 90° angular milling attachment, the Model 570-T is used to machine all window surfaces of the calender housing in a single setup. And equipped with the same angular attachment with stub boring bars, it is used for boring adjusting-screw and tie-bolt holes. Then, with the workpiece in horizontal position on the 60" x 96" rotary indexing table, further rough and finish boring is performed . . . and all external faces (not machined in vertical position) are faced to exact tolerances and angularity.

For complete specifications on G&L 50 Series Horizontal boring, drilling and milling machines, write for Catalog No. 50-T.

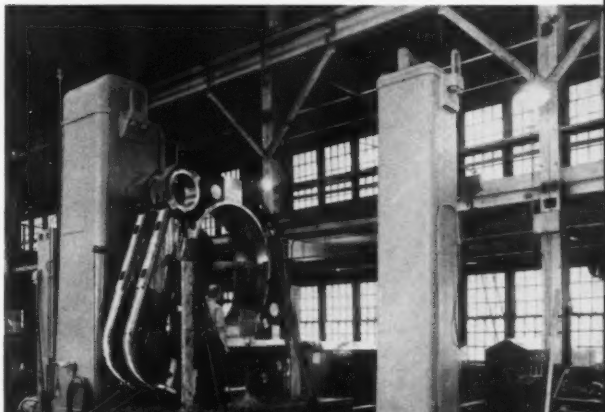


Here's the finished product—a 4-roll, Z-type calender. Each of its 14-ton cast-iron end frames is precision-machined on the G&L (table-type) Horizontal.

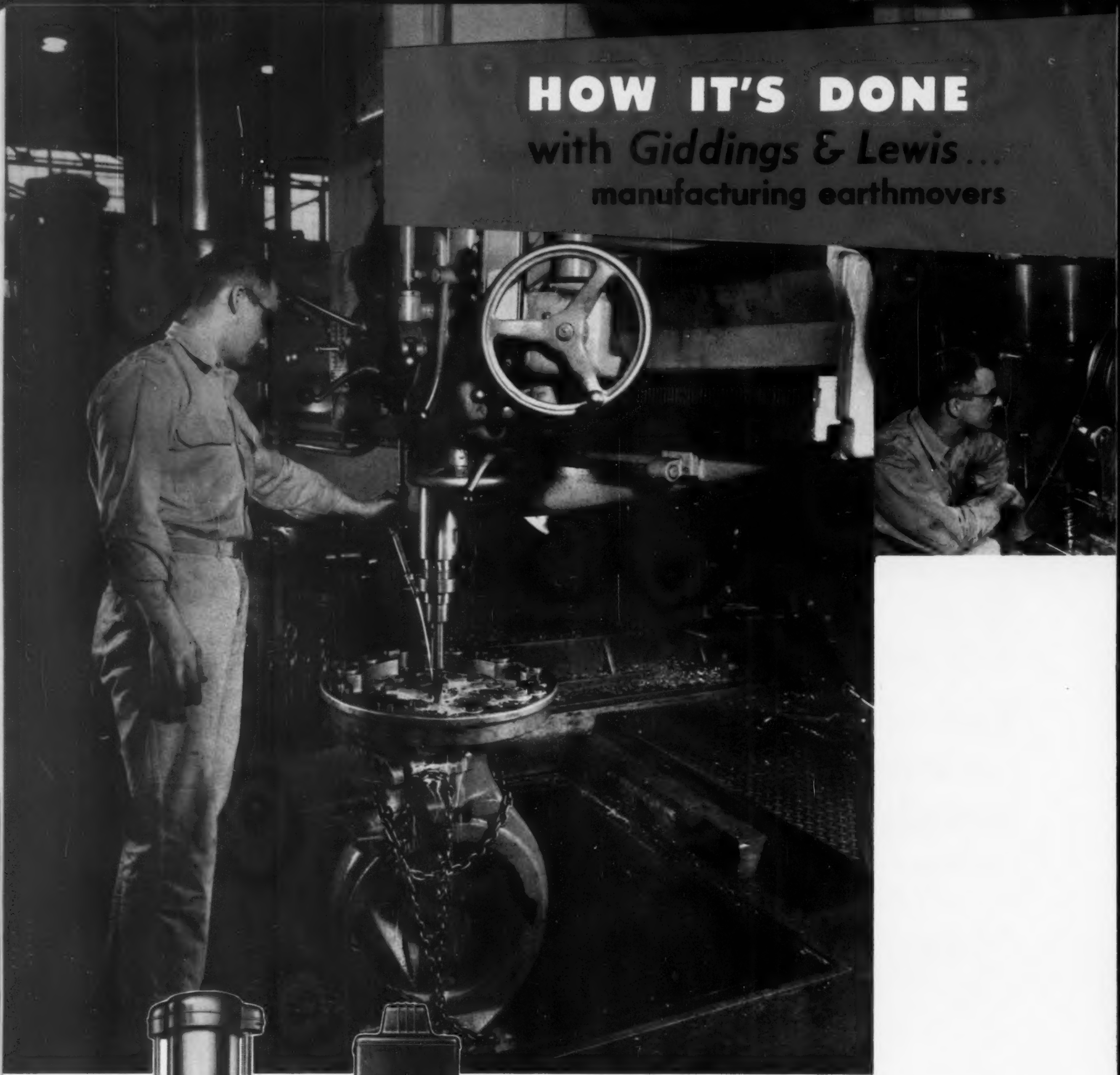
G & L *and* HYPRO DIVISION
GIDDINGS & LEWIS MACHINE TOOL CO.
FOND DU LAC, WISCONSIN

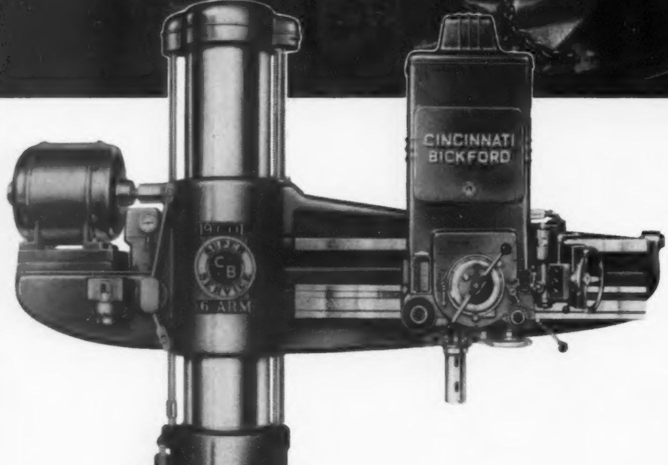
Builder of the world's finest heavy-duty Horizontal Boring, Drilling and Milling Machines—table, floor and planer types; HYPRO Double Housing and Openside Planers; Planer-Type Milling Machines; Vertical Boring Mills; Spar and Skin Milling Machines and VARIAX Milling Machines.

The Giddings & Lewis Model 570-T shown has continuous feed facing head and telescopic tool. It is shown precision boring a 65" dia. half-hole in two housings, set up side by side. All smaller boring operations are performed with Davis micrometer bar sets and block-type cutters.



HOW IT'S DONE
with *Giddings & Lewis*...
manufacturing earthmovers





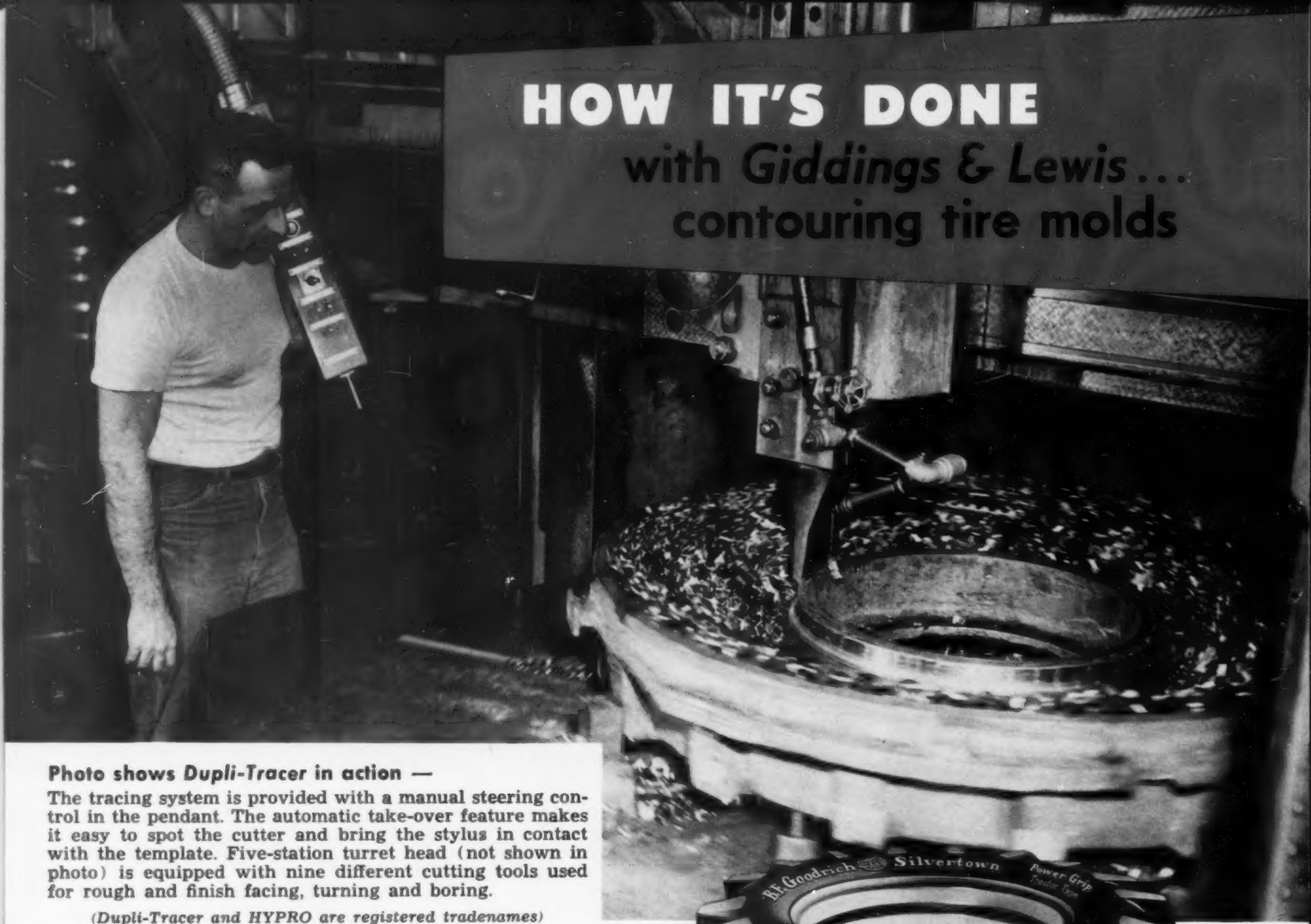
Special pit is used for positioning rear axle housing. Promotes fast, accurate drilling, tapping, core drilling and countersinking of various diameter holes. Note use of special drilling template with pilot bushings.

Super Service Radials with complete hydraulic pre-selection of 36 speeds, 18 feeds

Only a turn of the dials and all 36 spindle speeds and 18 feeds are hydraulically preselected while the spindle is running in either forward or reverse, or when stopped.

These new type Radials are available in sizes from 13″ column, 4′ arm to 19″ column machines with 8′ arm. Latest design developments assure fast, accurate drilling, boring, tapping, facing and reaming of materials ranging from tough alloy steel through cast iron to aluminum.

Super Service Radials are also available with special bases and tables to meet your specific work requirements.



HOW IT'S DONE
with *Giddings & Lewis* . . . contouring tire molds

Photo shows *Dupli-Tracer* in action —
The tracing system is provided with a manual steering control in the pendant. The automatic take-over feature makes it easy to spot the cutter and bring the stylus in contact with the template. Five-station turret head (not shown in photo) is equipped with nine different cutting tools used for rough and finish facing, turning and boring.

(Dupli-Tracer and HYPRO are registered tradenames)

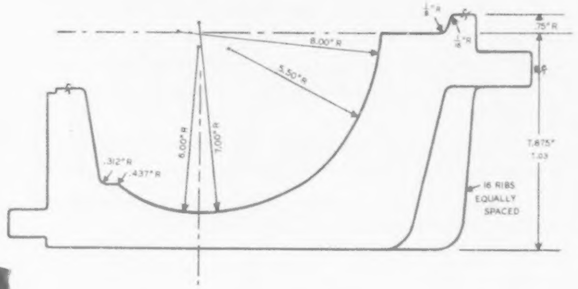
Minimize chance for human error in mold contouring!

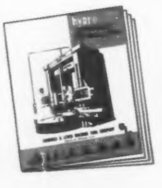
B. F. Goodrich does it! Uses *Dupli-Tracer*, 2-dimensional electronic contouring control, on a G&L 8-ft HYPRO Vertical boring mill

They're enjoying a greater measure of accuracy — virtually complete freedom from human error — contouring tire molds at B. F. Goodrich in Akron, Ohio. This money-saving performance is credited to Gidding & Lewis 8-ft. HYPRO Vertical boring mill equipped with the electronic contouring control.

Equipped with a tracing head, this control assures precision contour-duplication of various radii and diameters from a master template. Constant chip thickness and constant cutting speed are maintained to produce a surface which is finished velvet smooth for tire-cure.

The B. F. Goodrich tractor tire shown here is typical of the products cured in tire molds which are precision-machined on the G&L 8-ft HYPRO Vertical. Drawing below shows the degree of contouring required on (female) upper half of mold.





***LITERATURE AVAILABLE!** For all the facts about the ultra-sensitive 2-dimensional tracing and duplicating control — and specifications about HYPRO Vertical boring mills, see your G&L representative, or write for Catalog No. 54-12.*

G & L *and* HYPRO DIVISION
GIDDINGS & LEWIS MACHINE TOOL CO.
FOND DU LAC, WISCONSIN

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....machining automotive dies and molds

G&L Horizontal steps up production to help meet 50% sales boost at Loehr Die & Mold Company

It's a Model 300-T (table-type) Horizontal boring, drilling and milling machine with 3" dia. spindle, extended saddle and saddle supports, in-the-floor type auxiliary runways

THIS East Detroit specialist in precision-machining of die-cast dies, plastic molds, cavities and die engravings for automotive and other industries expanded production to meet soaring demand . . . purchased a Giddings & Lewis Model 300-T Horizontal.

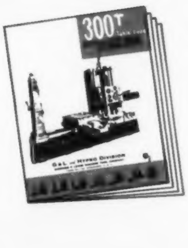
Simplicity of operation is assured with controls centrally located on the headstock for speed and accuracy. Forty-five spindle speeds, as low as 7 rpm, enables the operator to use the Horizontal as either a small or large milling machine for intricate precision die work. Additional advantages hailed by Loehr are the machine's full-length scales and verniers which permit locating hole centers to .001".

(Also on the job at Loehr Die & Mold Company, is a Super Service Radial with 5-ft. arm and 15" dia. column)

Here's a typical machining sequence:

Workpiece shown on Loehr's G&L 300-T Horizontal is a die-cast die block (40" x 42" x 6") which, when machining is completed, will be used in production of glove compartment doors for a brand new line of 1958 cars. Made of heat-treated steel with Rockwell hardness C 30-32, the die block weighs approximately 1.7 tons before machining . . . must have 417 lbs. of steel removed.

1. Outer surfaces are milled with 8.5" dia. high-speed steel face mill.
2. Pockets roughed out (upper and lower half of die block) by manual steering made possible by directional control with a 2" dia. end mill at 60 rpm, .83 ipm feed and average 1¼" depth of cut.
3. Four 2" dia. guide pin holes and bushings, 2" dia. sprue pin and bushing hole—rough and finish bored.
4. Pockets and inserts for the die are finish milled, holding plus or minus tolerances of .002".
5. Eight water line holes are drilled (7/16" dia., 15" long).
6. Workpiece is then moved to Loehr's Cincinnati Bickford Super Service Radial which is used for drilling and reaming several ¼" and ⅜" dia. ejector pin holes . . . drilling and tapping four ¾" dia. push back holes.



For complete specifications on G&L Models 300-T and 300-RT (revolving table-type) Horizontal boring, drilling and milling machines, contact your nearest G&L representative or write for catalog No. 300-T.

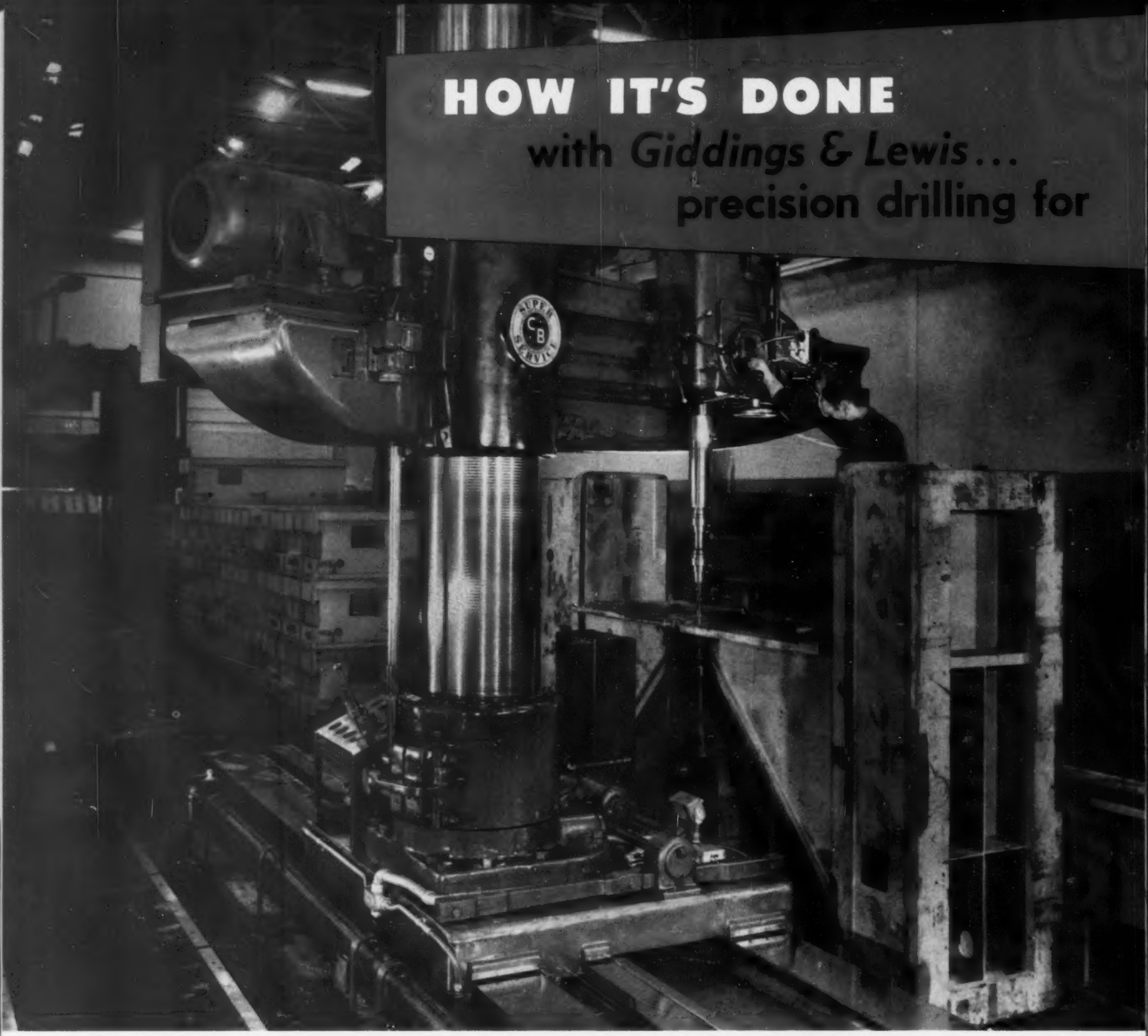
HYPRO

G & L and HYPRO DIVISION
GIDDINGS & LEWIS MACHINE TOOL CO.
FOND DU LAC, WISCONSIN

Builders of the world's finest heavy-duty Horizontal Boring, Drilling and Milling Machines—table, floor and planer types; HYPRO Double Housing and Openside Planers, Planer-Type Milling Machines; Vertical Boring Mills; Spar and Skin Milling Machines, and VARIAX Milling Machines.

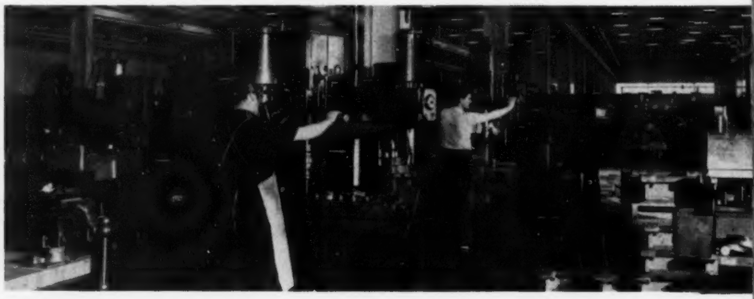
HOW IT'S DONE

with *Giddings & Lewis*... precision drilling for



Drilling, tapping on angular column workpiece of SAE-1020 steel:

1. Drill one 2 15/64″ hole.
2. Drill ten 1 1/16″ holes.
3. Drill one ¾″ hole, core drill 2½″ dia., core drill to 3¾″ diameter.
4. Drill and tap fourteen ⅞″ leveling screw holes.
5. Drill ten ⅜″ holes and tap .9″ deep.
6. Drill six 13/16″ hold-down holes.
7. Drill four ¼″ holes and tap .6″ deep.



This Cincinnati Bickford Super Service Radial, (6-ft. arm, 19″ dia. column) on 16-ft. dia. round floor plate, is used for production drilling of 24 workpieces clamped on parallels arranged 360 degrees around the machine. Setup permits continuous drilling, saves approximately 30% in floor-to-floor time. Picture shows reaming a 1.250″ hole at 140 rpm, .016 ipr. Hole is also back spot-faced to 2½″ dia.

world's largest builder of transfer machines

The Cross Co. saves up to 40% in setup and floor-to-floor time with Cincinnati Bickford Super Service Radials

When The Cross Company required precision, high-production drilling and tapping in the manufacture of their "Transfermatics," they chose a Cincinnati Bickford Super Service Radial. According to Burton Winke, shop supervisor, their first Super Service has now been in operation 15 years. It works 20 hours a day, six days a week — and has required only routine maintenance.

Today Cross uses eight Super Service Radials and one Super Service precision layout drilling machine with automatic spacing table. Other G&L machines at Cross include two Model 340-T and two Model 350-T Horizontal boring, drilling and milling machines.

Gets continuous production

One example of the savings achieved with these Radials is the drilling and tapping of 39 different radius holes in angular columns for Cross's multiple-spindle drilling slide units. Four of the angular columns are drilled and tapped on one side of the Radial, while another four are being set up on the other side. Production never stops, and the result is a saving of approximately 40% in setup and floor-to-floor time. Comparable efficiencies are obtained in the drilling, reaming and tapping of components for other Cross machines.

For complete specifications on the broad line of Super Service Radial Drills featuring choice of complete or partial hydraulic pre-selection, or lever control of all speeds and feeds, see your nearest Cincinnati Bickford representative, or write for new Bulletin.

In addition to the 6-ft. arm Radial, the Cross plant at Fraser, Mich., has an 8-ft. with a traveling base, another 6-ft. and five 4-ft. arm Super Service Radials for drilling and tapping a wide range of steel workpieces.

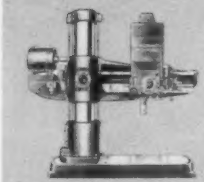
CINCINNATI BICKFORD DIVISION

GIDDINGS & LEWIS MACHINE TOOL CO.

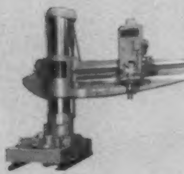
CINCINNATI, OHIO

Radial Drilling Machines, Upright Drilling and Tapping Machines, Layout Drilling Machines, Gang Drills and Precision-Drilling Machines designed for use with Spacing Table.

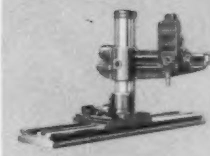
Choose from these top-performing Cincinnati Bickford drilling machines



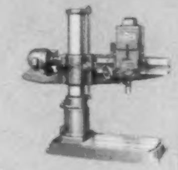
NEW SUPER SERVICE RADIAL DRILLS with complete hydraulic preselection of all 36 speeds and 18 feeds. Sizes: 13" column, 4' arm to 19" column, 8' arm.



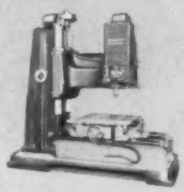
MASTER SUPER SERVICE RADIAL DRILLS — available with 40 hp motors, sizes up to 26" col. and 12' arms. All types of bases including track type.



SLIDING-BASE SUPER SERVICE RADIAL DRILLS — —designed for high production, minimized setup time. All controls centralized on heads. In complete size range with 3' to 12' arms.



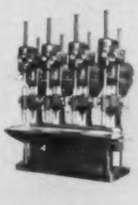
HIGH-SPEED SUPER SERVICE RADIAL DRILLS — choice of 6 spindle speed ranges, from 3500 rpm down to 60 rpm with 3 hp motor. Available with 3' or 4' arms.



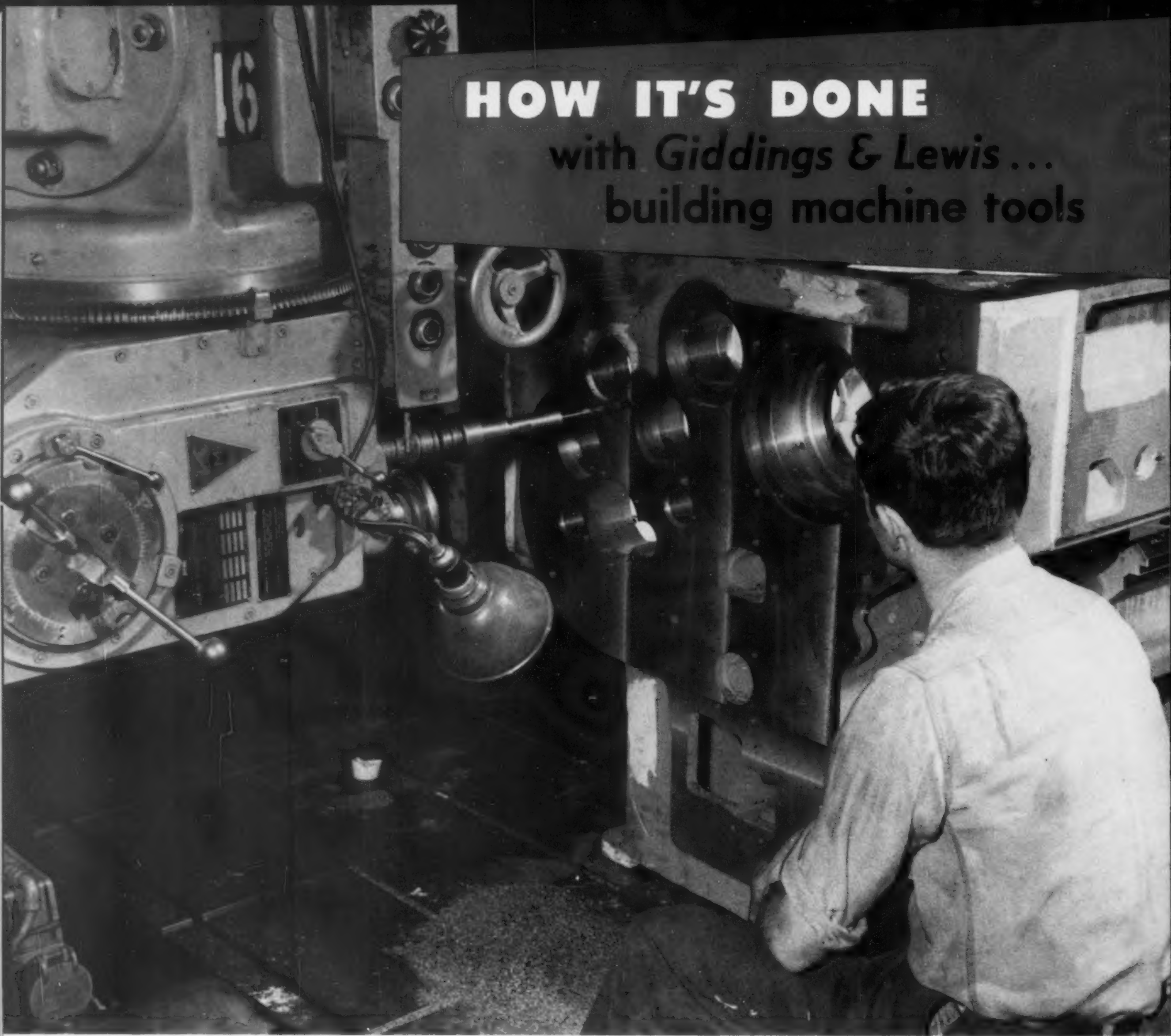
SUPER SERVICE PRECISION DRILLING MACHINE—specially suited to operations with automatic spacing table. For precision production work, jigs can be eliminated.

ALL-GEARED ROUND COLUMN UPRIGHT DRILLS in three sizes (21", 24" and 28") with 9 to 12 speeds.

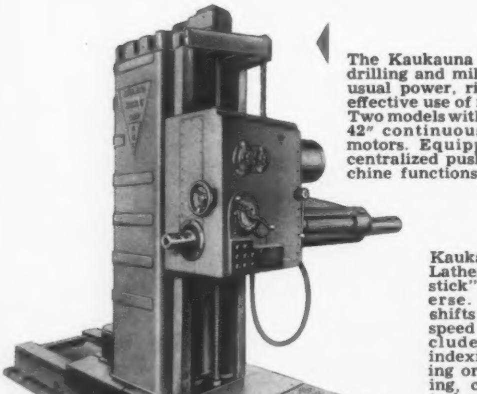
ALL-GEARED BOX COLUMN UPRIGHT DRILLS—24" unit with 5 hp motor, 28" with 5 or 7½ hp.



SUPER SERVICE BOX COLUMN GANG DRILLS have entire mechanism in upper section. Each spindle is individually driven, saving time and space on successive operations.

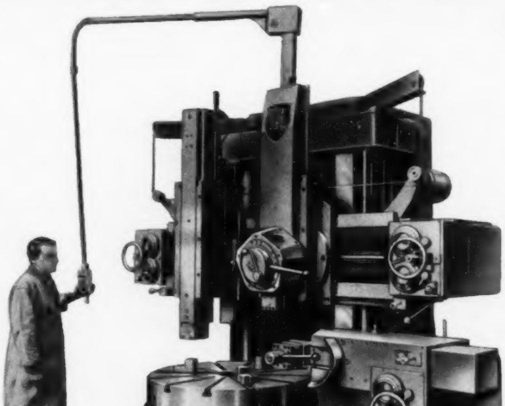


Extend your production profit range
Kaukauna Horizontal drilling, tapping



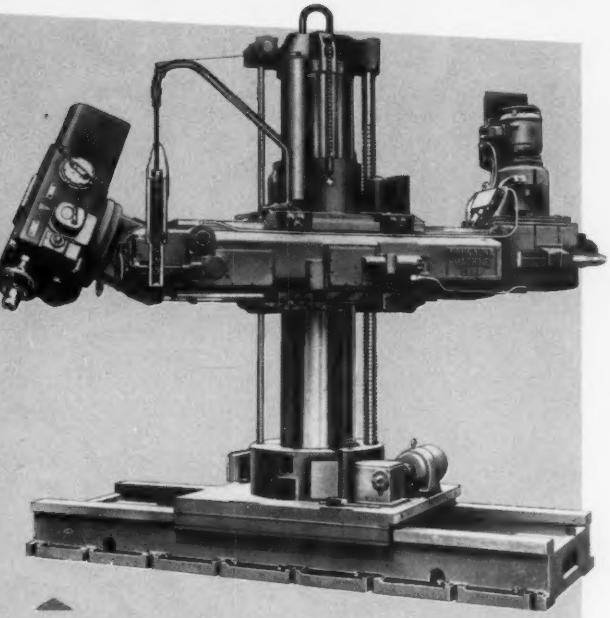
The Kaukauna line of Horizontal boring, drilling and milling machines features unusual power, rigidity and accuracy. Most effective use of modern, high-speed tooling. Two models with choice of 4″ or 5″ spindles, 42″ continuous travel, 20 or 25-hp drive motors. Equipped with dynamic brake, centralized push-button control of all machine functions.

Kaukauna line of Vertical Turret Lathes features 50-hp drive, "joy stick" control of feed and traverse. Planetary transmission shifts feed *on-the-fly* and changes speed *in-the-cut*. Accessories include power chuck and turret indexing, tracer control, threading or drum scoring, taper turning, constant surface speed attachments, coolant system.



At Warner & Swasey, they perform radial, horizontal, angular and compound-angular drilling

all in one setup!



Kaukauna Universal Radial drilling machines are available in 6-ft. arm, 14″ dia. column and 8′-10″ arm, 9′-10″ arm 22″ dia. column, with spindle drive motors ranging from 2-20 hp. Complete pendant control of all powered machine functions including speed changing, column and runway movements . . . . final tool location by electrical push button control. Bails, leveling jacks and spreader arms built-in . . . permit conveniently moving machine to work, eliminating hand drilling or tapping.

KAUKAUNA MODEL 125-U UNIVERSAL RADIAL is used by Warney & Swasey, Cleveland, for drilling operations on lathe beds, and head castings of various sizes. Machinists consider this tilting head Kaukauna one of the safest and easiest-operating universal radial drills in the plant. They particularly like the fact that the Universal Radial can be securely locked in any position for drilling, tapping and spot facing operations.

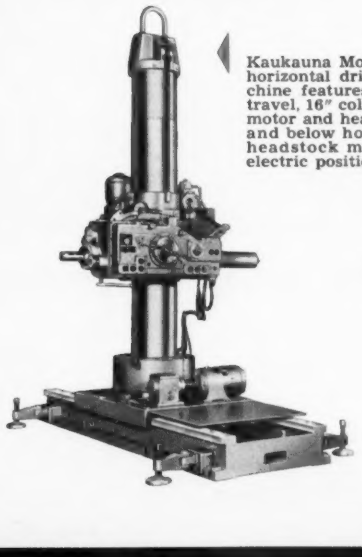
At left, the Universal Radial is shown on the job — drilling, boring, tapping, counter-boring and reaming more than 60 holes of varying sizes in turret lathe bed and head casting. Workpiece is hi-nickel iron (ASTM-A48, Class 50), weighing approximately two tons.

Here's the production sequence:

1. One 47/64″ hole drilled at 465 rpm, reamed at 30 rpm, .012 ipr feed.
2. Sixteen 27/64″ holes drilled at 690 rpm, .007 ipr feed.
3. One 11/32″ hole drilled at 690 rpm, tapped at 340 rpm.
4. Ten 21/32″ holes drilled 465 rpm, .012 ipr feed . . . counter-bored and tapped at 160 rpm.
5. Seven 17/32″ holes drilled at 465 rpm, .007 ipr. feed . . . body counter-bored and tapped at 240 rpm, hand-feed.
6. One 55/64″ hole drilled 11″ deep at 240 rpm, .007 ipr feed . . . reamed 9/16″ deep at 160 rpm, .012 ipr feed.
7. Two 7/16″ holes drilled 4″ deep at 690 rpm., .007 ipr feed.
8. Twenty-two 5/16″ holes drilled 2″ deep at 690 rpm, .007 ipr feed . . . body counter-bored and tapped at 240 rpm, hand feed.
9. One 7/16″ hole drilled 3″ deep at 240 rpm, hand tapped.
10. Two 21/32″ holes drilled at 465 rpm, .012 ipr feed . . . back spot-faced 1″ at 160 rpm, hand feed.

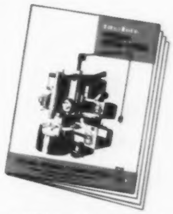
For facts about production profits, contact your Kaukauna sales representative.

with rugged and boring machines



Kaukauna Model 1030 Tilting Head horizontal drilling and tapping machine features 3″ spindle with 24″ travel, 16″ column. Has 7½ hp drive motor and head that tilts 45° above and below horizontal. All controls headstock mounted . . . complete electric positioning provided.

For complete specifications and information on new line of Vertical Turret Lathes write for catalog VTL-3.



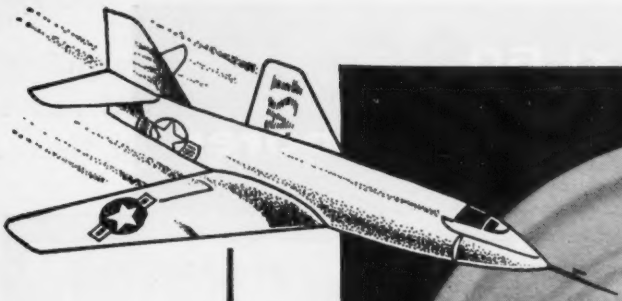
KMF

KAUKAUNA MACHINE & FOUNDRY DIVISION

GIDDINGS & LEWIS MACHINE TOOL CO.

KAUKAUNA, WISCONSIN

Vertical Turret Lathes, Universal Radial Drilling Machines, Horizontal Drilling, Tapping and Boring Machines, Gray Iron Castings.



the heart of the jet . . .

—DEPENDABLE FORGINGS—

Ever since the beginning of the development of mechanical power, the heart of power producing machinery has been forgings.

The latest development in the field of mechanical power is the aircraft turbo-jet engine. Here again, the important highly stressed components — the turbine wheels and the compressor discs — are forgings and here also more of these forgings are produced by Wyman-Gordon than by any other company.

Entirely new problems, mechanical and metallurgical, are involved in the production of these vital parts — problems which require the maximum in experience, know-how and research facilities. Wyman-Gordon excels in all of these areas and continues today as for nearly 75 years in the forefront of new forging developments.

Seen through the porthole of this compressor disc is the finished forging — an example of the ultimate in quality and precision.

WYMAN-GORDON COMPANY

Established 1883

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM
WORCESTER 1, MASSACHUSETTS
HARVEY, ILLINOIS • DETROIT, MICHIGAN

dixi 60

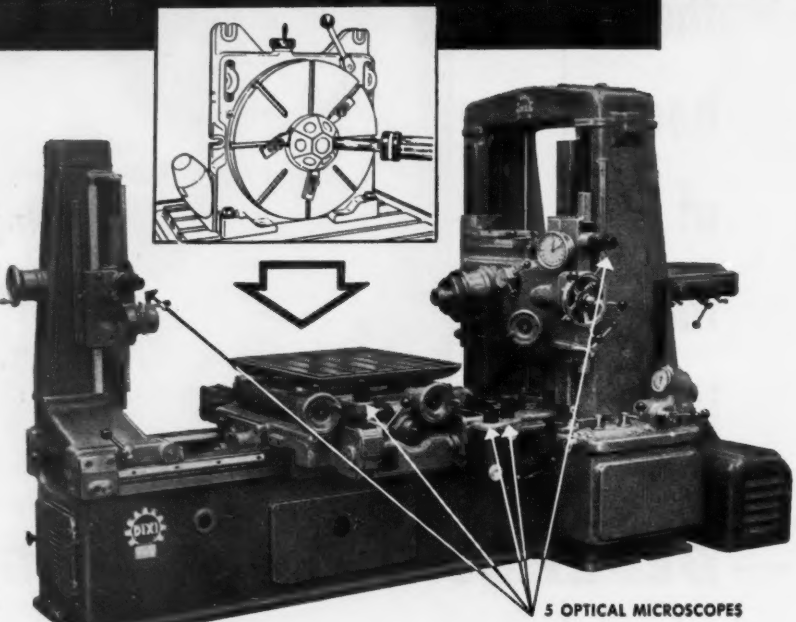
horizontal optical jig borer

with 5 optical microscopes

DESIGNED AND BUILT FOR:

VERSATILITY
Optical settings for operations in all planes and compound angles . . . Equally suitable for tooling, short-run or production work . . .

ACCURACY
Overall accuracy of .0002"



A precision machine for *JIGLESS* boring, facing, milling, and drilling work, in all planes. Built-in 360° optical rotary table, 28¾" x 32⅝". All spindle and table settings by optical microscopes. Infinitely variable hydraulic feeds. Mechanical spindle feeds with automatic depth stop. #40 taper spindle-speeds infinitely variable to 1400 R.P.M. Special features eliminate effect of spindle overhang on accuracy.

DIXI 450 PRECISION OPTICAL CIRCULAR DIVIDING TABLE

Direct readings of 1 sec.

(See insert picture above) rigidly mounted (not tilting) on built-in rotary table permits holding close tolerance relations between bores in all planes, including bores at compound angles. ALL IN ONE SET-UP. All sides of the work piece except the mounting face machined in one set-up.

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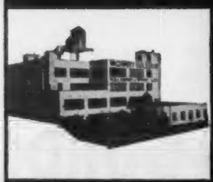
- ***Engineering staff available for consultation***
- ***Spare Parts in New York stock***
- ***Your operators trained***

DIXI 60 now in wide use in leading Aircraft and Manufacturing Plants throughout the United States.
Names available upon request.

SEE THIS VERSATILE MACHINE IN OPERATION
at our New York or Cleveland Show Rooms. Write for Complete descriptive literature and prices to Department 21. Catalogues on additional production equipment also available on request.

MBI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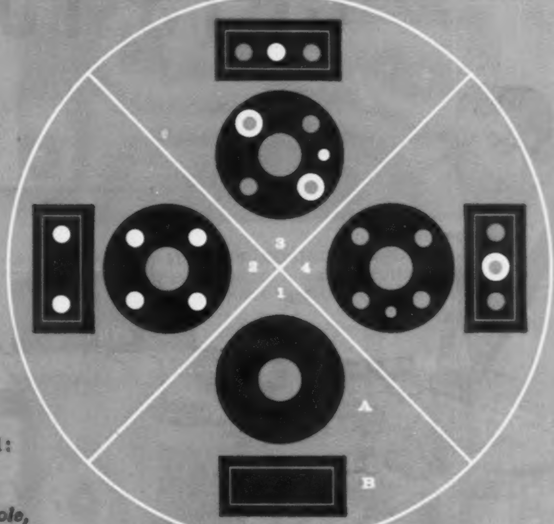
For more information fill in page number on Inquiry Card, on page 259

Natco Naturals

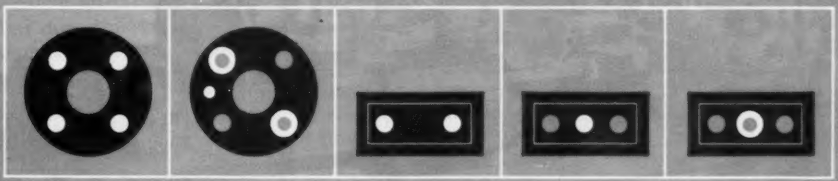
Cost-Cutting Ways
You Can Use
Standard Multi-Spindle Natcos

Any time your parts require machining *more than one hole*–drill, bore, face or tap–it may well be a "Natco Natural." Your standard Natco will produce substantial savings in a surprising number of situations, *even in small job-shop lots!* Call in your nearby Natco field engineer; he'll tell you in short order whether you've got a "Natco Natural" there.

Multiple Drilling Operations on Two Part-faces

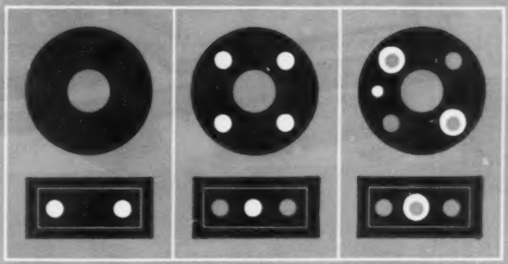


130 parts per hour–4-position rotary table. Position #1: *Unload finished part, transfer half-finished part, load new part.* Position #2: *Drill 4 holes, Face A. Drill and countersink 2 holes, Face B.* Position #3: *Drill 1 hole, ream 2 holes, Face A. Drill 1 hole, Face B.* Position #4: *Trepan 1 hole, Face B.*

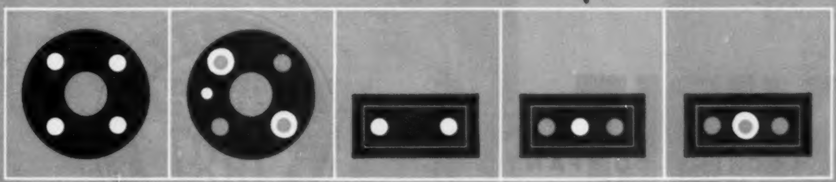


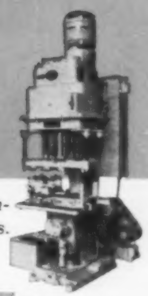
65 parts per hour–stationary fixture *with 5 work locations. Operator transfers parts after each stroke. One part completed per stroke.*

40 parts per hour–straight-line indexing. *After every 3 strokes, operator unloads finished part, transfers half-finished part and loads fresh part.*



23 parts per hour–tumble-type fixture. *Operator transfers and tumbles fixture from one position to the next. One part completed every five strokes.*





Standard multi-spindle Natcos range from 1 hp, 10-spindle machines to 50 hp machines with up to 72 spindles. Spindles in standard Natcos are driven through universal joints and located by either adjustable arms of bored slip plates.

NATCO

National Automatic Tool Company, Inc.

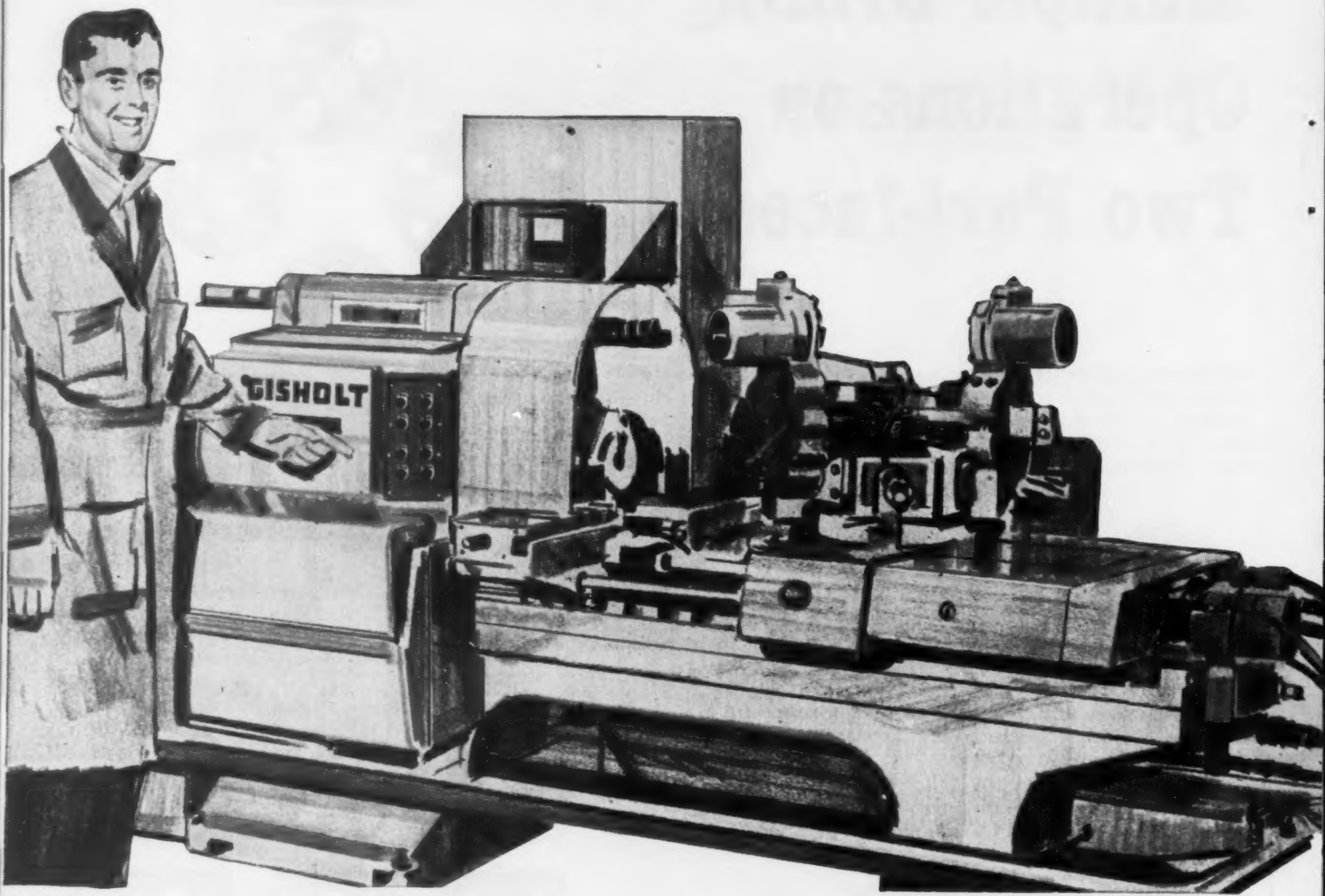
Richmond, Indiana

Multi-spindle drilling, boring, facing & tapping machines. Special machines for automatic production.

Call Natco Offices in Chicago, Detroit, New York, Buffalo, Boston, Philadelphia, Cleveland, Los Angeles; distributors in other cities.

NEW Gisholt Fastermatic

CUTS YOUR SETUP TIME



GISHOLT MACHINE COMPANY

Madison 10, Wisconsin

MASTERLINE
GISHOLT SINCE 1887

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • PACKAGING MACHINES • MOLDED FIBERGLAS PLASTICS

no wonder this shop is "100%

Machine Utilization

98%

The result of *extreme machine rigidity* which maintains precise tool settings throughout the run . . . keeps down-time to an absolute minimum (in this case an average of only 16 minutes per machine per shift).

Cycle Efficiency

75%

Made possible by Acme-Gridley *Controlled Cycle* operation, which assures a steady, predetermined production pace.

"Acme-Gridley"

"We call 'em workhorses" says Mr. Bob Barnd, Factory Manager of Eaton Screw Products Plant, Tube & Hose Fittings Division of the Parker Appliance Co., describing the Acme-Gridley Bar Automatics and Chuckers in this 100% Acme-Gridley equipped Eaton Ohio plant.

Carefully kept records certainly prove these Acme-Gridleys can take it. They are operated two 8-hour shifts a day, five days a week—with a utilization factor of 98%, combined with a cycle efficiency of 75%. In a period of one month, they produce well over two million hydraulic tube and hose fittings. "The machines themselves," says Mr. Barnd, "are largely responsible for our low down-time. Once setup, they are rigid enough to maintain the most precise setting, shift after shift."

* * * *

This is typical of Acme-Gridley performance all over the world. It is the end result of two important Acme-Gridley basic design features: (1) *controlled cycle time*, which maintains a steady, hour-after-hour, predetermined production pace; and (2) *extreme machine rigidity*, that comes from being built with an ample reserve of beef, properly distributed, for an extra margin of assurance today—and for any additional burden tomorrow's tooling requirements may place upon them.

why don't you
INDEX . . . to lower machining costs . . .
with *Acme-Gridley*
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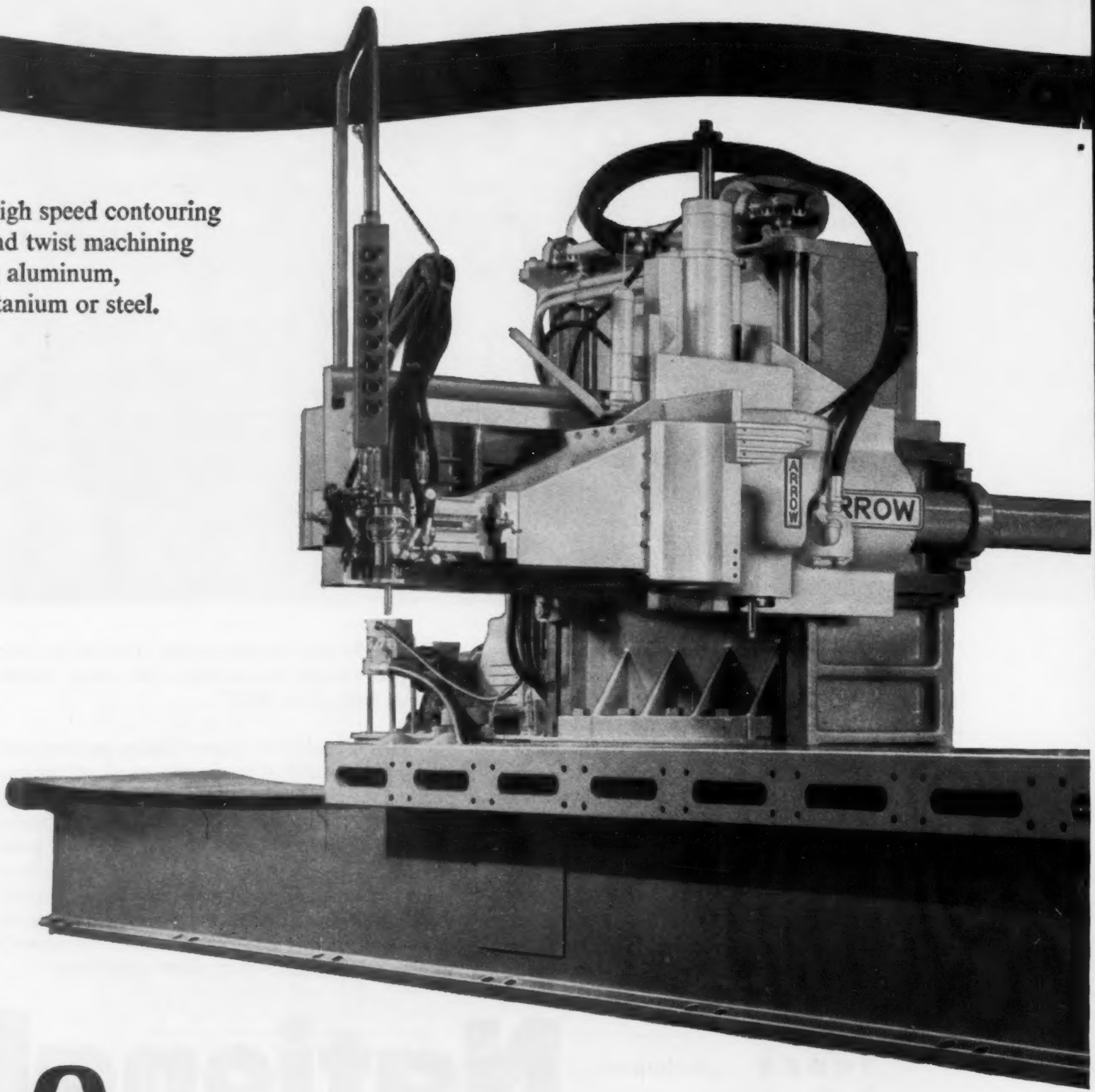
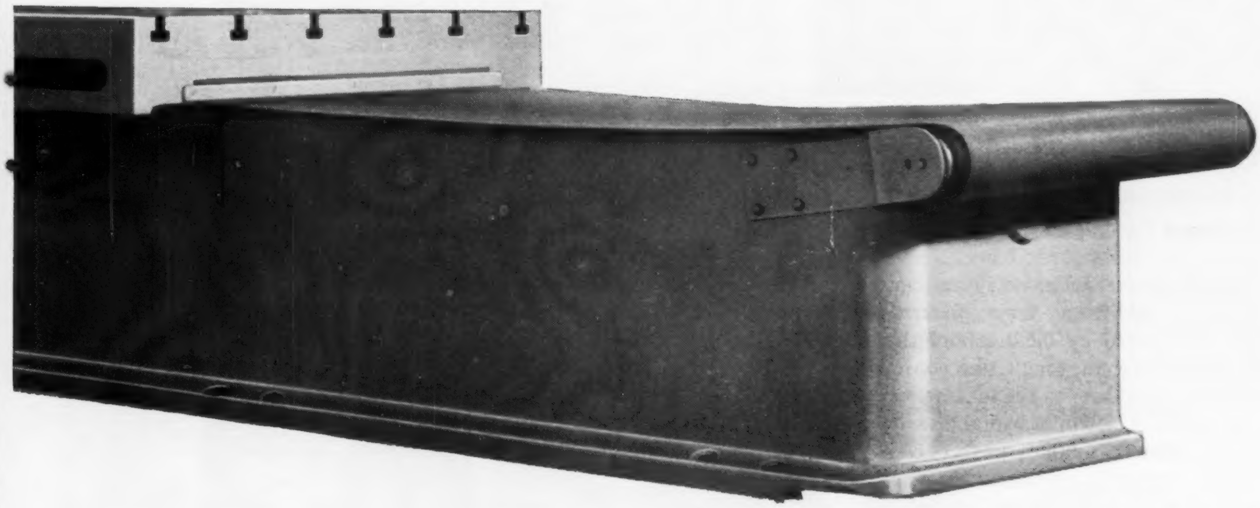
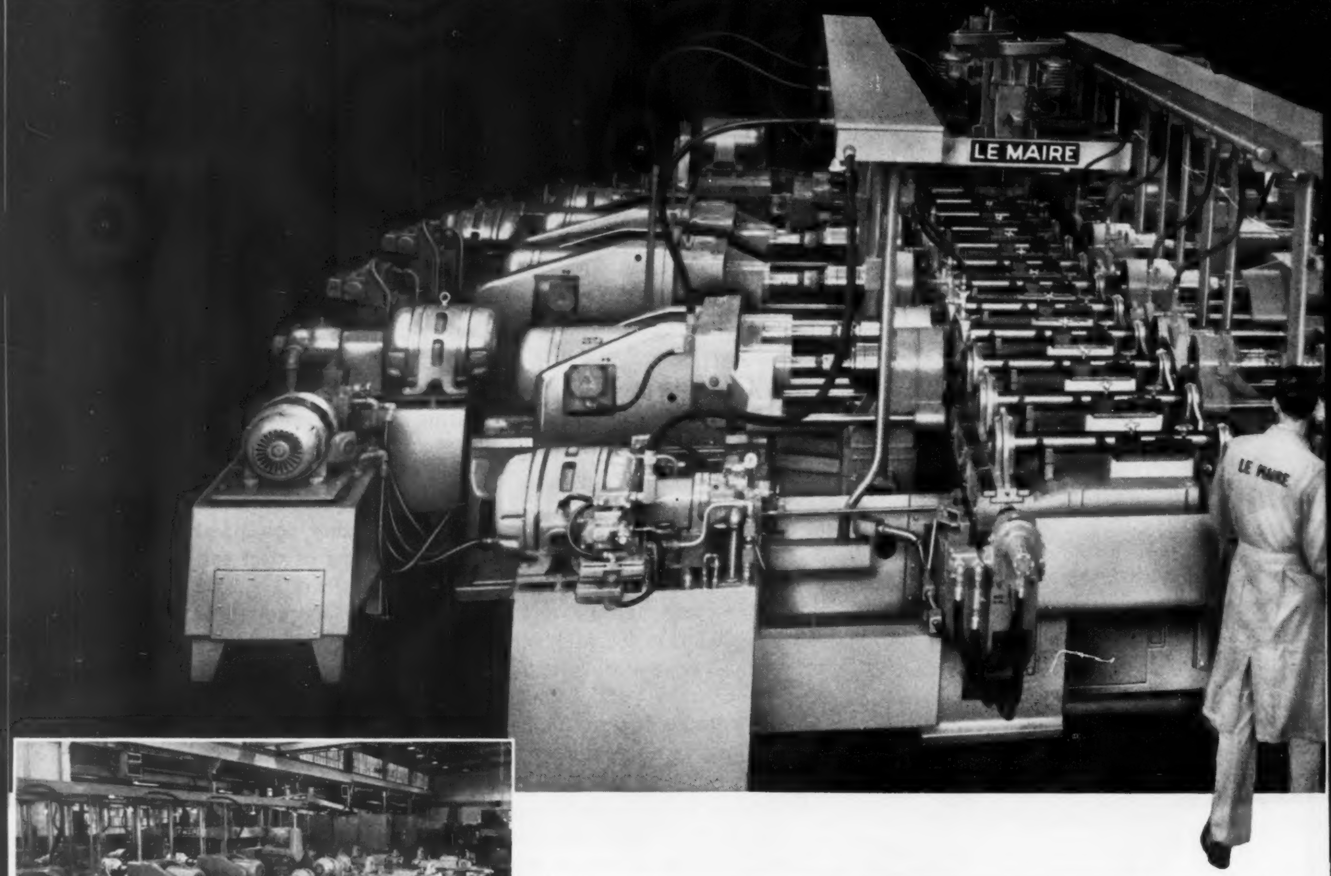
High speed contouring
and twist machining
in aluminum,
titanium or steel.

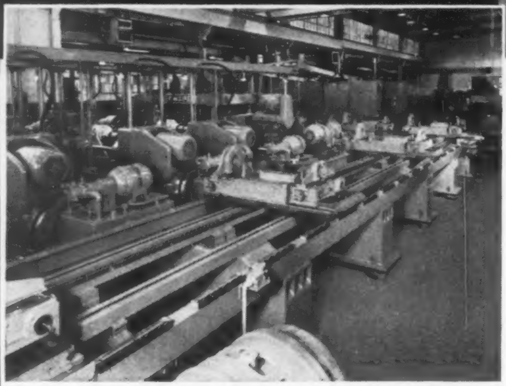


ARROW ENGINEERING COMPANY, INC., 120 East Market Street, Indianapolis, Indiana



PRODUCING



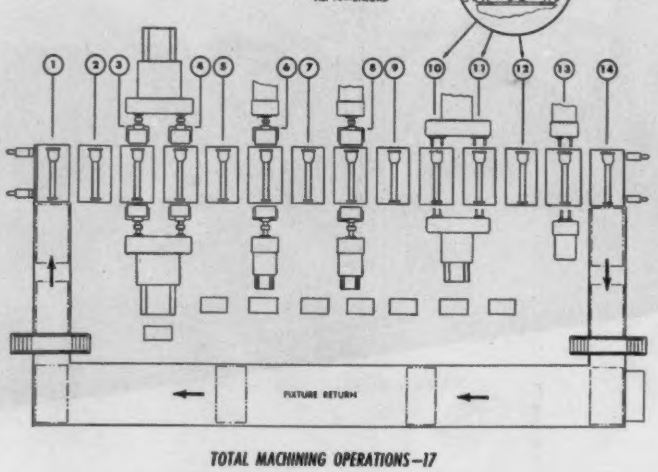


Huge Half-ton Fixtures Automatically Returned under "Fingertip Control"

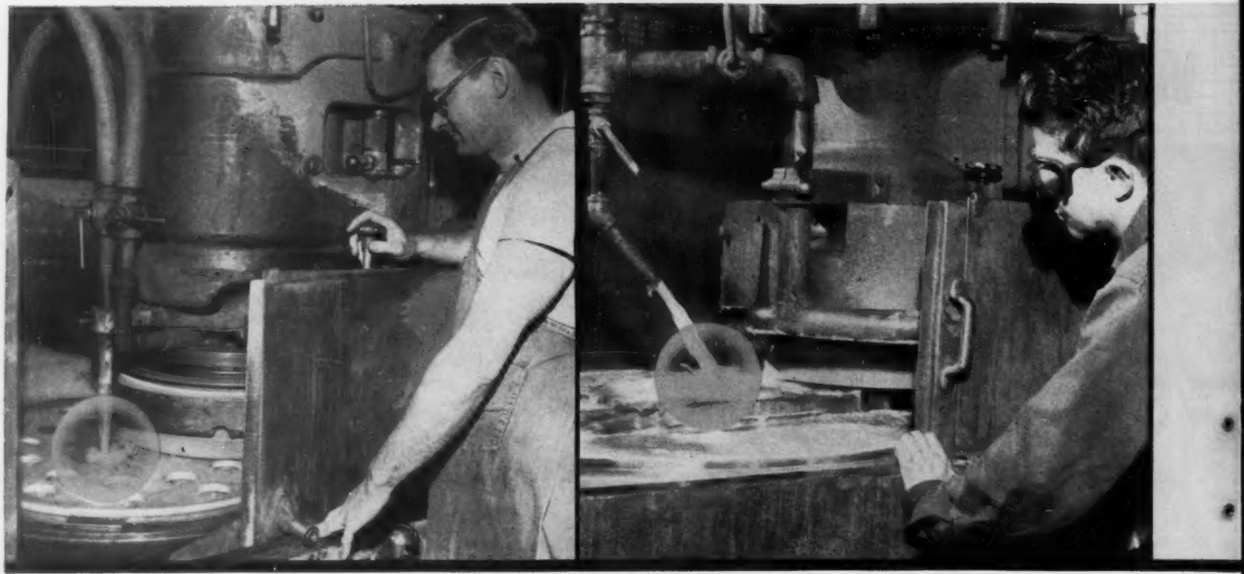
Finished parts are automatically unclamped at the unload station. Empty fixtures are then transferred by the LeMaire shuttle bar conveyor to the long return conveyor, which returns them to the loading end at high speed. A system of hydraulic decelerating valves maintains perfect control during completely automatic handling of these 21 huge, 1,150 pound fixtures.

WORK STATION LAYOUT, LE MAIRE 14-STATION TRANSFER MACHINE

No. 1—LOAD
No. 2—IDLE
No. 3—ROUGH BORE AND CHAMFER (BOTH ENDS)
No. 4—FINISH BORE (BOTH ENDS)
No. 5—IDLE
No. 6—ROUGH FACE (BOTH ENDS)
No. 7—IDLE
No. 8—FINISH FACE (BOTH ENDS)
No. 9—IDLE
No. 10—(HORIZONTAL) DRILL FLANGE HOLES (BOTH ENDS) (VERTICAL) DRILL MOUNTING BRACKET HOLE
No. 11—(HORIZONTAL) REAM FLANGE HOLES (BOTH ENDS) (VERTICAL) REAM MOUNTING BRACKET HOLE
No. 12—(VERTICAL) CHAMFER MOUNTING BRACKET HOLE
No. 13—DEBURR FLANGE HOLES (BOTH ENDS)
No. 14—UNLOAD



TOTAL MACHINING OPERATIONS—17



When you surface grind with segments

Take advantage of this COMPLETE Line

...and add the profit-boosting "Touch of Gold" to any surface grinder

You can be sure that switching from grinding wheels to Norton abrasive segments brings powerful, profit-building "Touch of Gold" benefits to very many jobs.

Because —

Norton makes segments in every required shape and size and in exactly the right abrasive and bond for best results in the widest variety of surface grinding — on ferrous and non-ferrous metals and on work pieces ranging from boiler plate to the hardest die steels, die sets or blocks.

Norton segments are made in many ALUNDUM* abrasives. Of these, 32 ALUNDUM abrasive is particularly suited for fast stock removal and heavy feeds. 37C CRYSTOLON* abrasive, unequalled on hard cast iron and soft non-ferrous metals, is also available. And diamond segments are also furnished, if desired, for ceramics, quartz and glass.

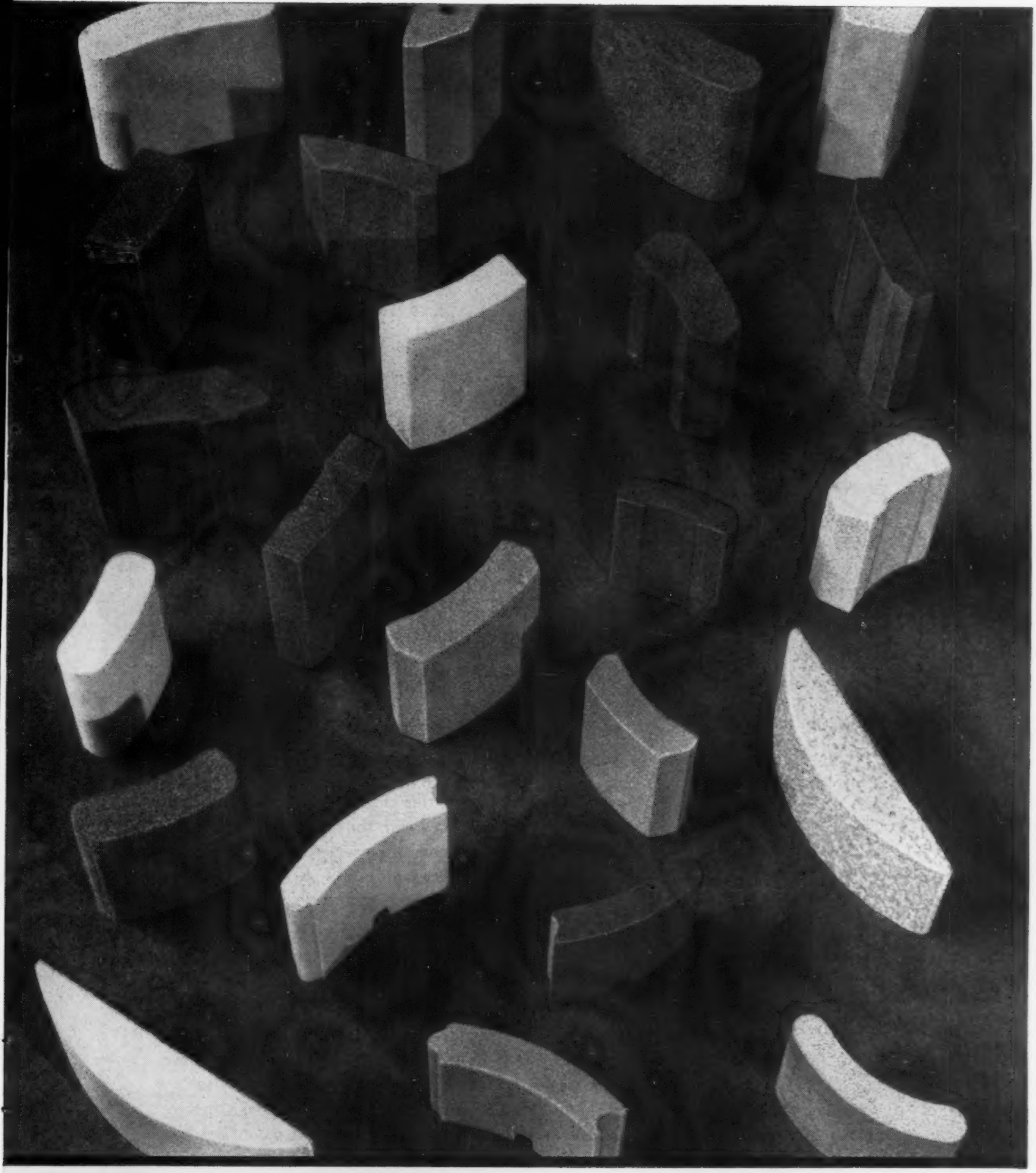
Bonds include the G and BE — both vitrified — as well as resinoid bonds. Structure can be either regular or the open (induced pore) which is especially advantageous for many jobs. In the field of surface grinding, users have reported that the G Bond — most efficient vitrified bond ever developed — results in new speed and economy.

With this broad range of abrasives and bonds to choose from you can count on much faster production rate at considerably lower costs. And when you mount these cost-cutting segments in Norton chucks — designed to fit several machines — you safeguard performance and profits.

Ask Your Norton Distributor for the booklet, "The A.B.C. of Surface Grinding." Or write to NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

W-1802

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries



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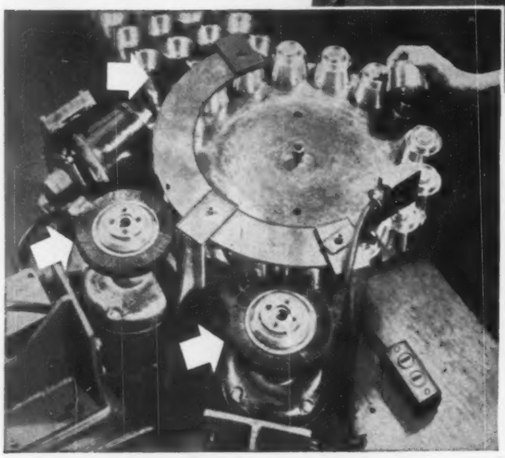
OSBORN BRUSHING METHODS *worthy of your confidence*

BEFORE BRUSHING

AFTER BRUSHING



At the push of a button.
Osborn Master® Wheels remove burrs and blend surface junctures. Costs are down 74% from previous hand method.

Push-button finish... 1400 per hour

THE manufacturer of this machined aluminum ammunition component was faced with the necessity for attaining a high production rate, and at the same time, meeting the standards of rigid quality control.

Working closely with the Osborn representative, he built the rotating fixture shown above. Three Osborn Master® Wheels quickly remove feather burrs, blend surface junctures. Uniformly finished parts come through at the rate of 1400 per hour.

Osborn offers its services to you without obligation. A qualified **O**sborn **B**rushing **A**nalyst is available wherever industry centers. He will welcome the opportunity to work with you. Write *The Osborn Manufacturing Company, Dept. D-36, 5401 Hamilton Avenue, Cleveland 14, Ohio.*

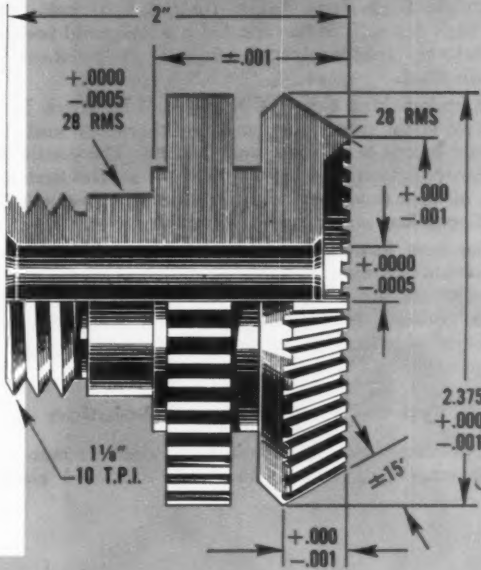
Write TODAY for the new 100-page Osborn Catalog 210-C.

Osborn Brushes

BRUSHING METHODS • POWER, PAINT AND MAINTENANCE BRUSHES • BRUSHING MACHINES • FOUNDRY MOLDING MACHINES

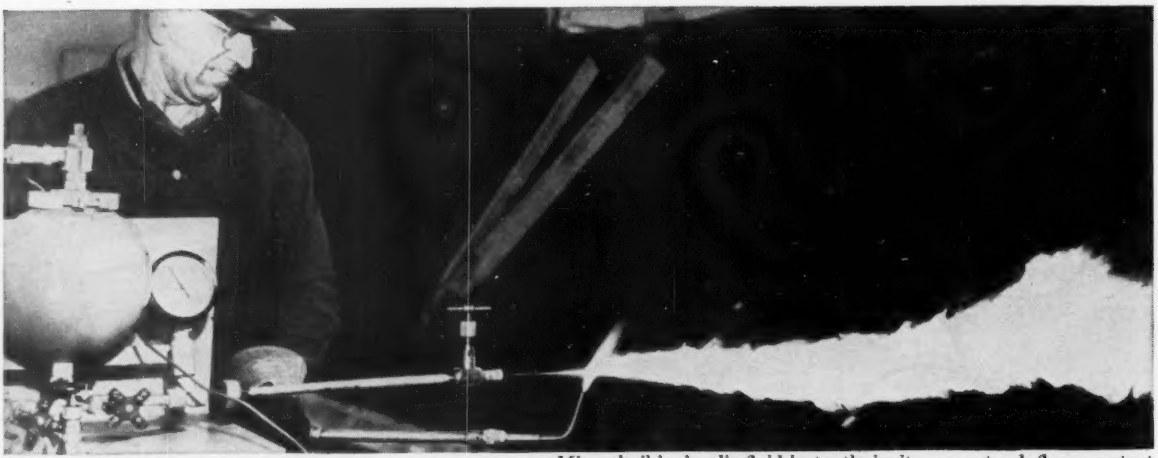
CAN YOUR PRESENT AUTOMATIC EQUIPMENT
make this
BEVEL CLUSTER GEAR
***complete* FROM BAR STOCK**
in one operation
READY FOR GEAR CUTTING?
...it can be done on the

TAREX



RUSSELL, HOLBROOK & HENDERSON, INC.

292 Madison Avenue, New York 17, N. Y.



Mineral oil hydraulic fluid instantly ignites upon torch flame contact

Fire resistance plus low cost

FOR MANY YEARS frequent industrial fires involving hydraulic fluids have taken their toll in man-hours and high costs. This has created a widespread need for a relatively inexpensive all-purpose, fire-resistant hydraulic fluid.

In undertaking this challenge, Shell Research Laboratories spent over four years in laboratory and field testing before a solution was reached. The result was the introduction of Irus* Fluid 902 . . . the first low-cost, oil-base fluid that, under plant conditions, actually snuffs out fire.

The new formulation is a specific combination of petroleum oils mixed with water and emulsifying agents. It gains its fire resistance through a relatively high water content. Irus Fluid is perfectly adapted to the majority of hydraulic systems. The following is typical of many reports in Shell files.

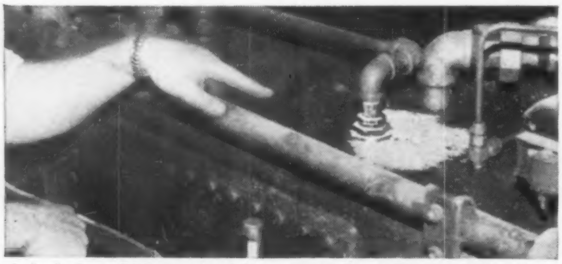
Typical Problem and Solution

The welding plant of a prominent automotive manufacturer employing 100 hydraulically operated electric welders formerly used a straight mineral oil fluid. On one occasion, damaged fluid lines allowed this mineral oil under high pressure to spray directly onto the welding area. Sparks ignited the fluid . . . caused an immediate flash fire which resulted in 75% machinery damage before it was extinguished. Immediately following this incident, the changeover was made to Shell Irus Fluid 902. Shortly thereafter a line broke and the high-pressure spray once more contacted welding sparks. There was no fire at all . . . and in a matter of minutes the machinery was operating at full efficiency.

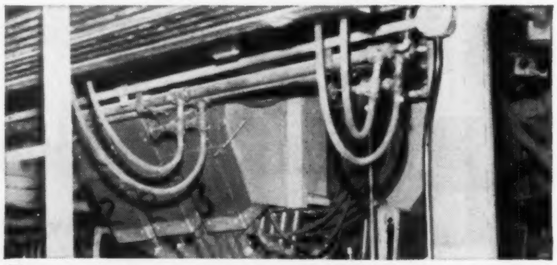
The two photos above provide dramatic proof of its flame resistance. In the photo on the left, conventional hydraulic fluid instantly ignites upon contact with an oxy-acetylene torch flame, whereas Shell Irus Fluid 902 (right photo), under the same conditions, does not support combustion beyond an inch or two from the flame. *Under plant conditions, it actually snuffs out fire!*

Two-Way Economy

An advantage not to be overlooked is the low cost of Irus Fluid 902. Many plant operators now making the



A leak is quickly spotted because of Irus Fluid's distinctive yellow color.



The complexity of cable lines necessitates the use of a fire-resistant hydraulic fluid to eliminate fire hazard.

Under the same conditions, Shell Irus Fluid 902 clearly demonstrates its fire resistance

in a new hydraulic fluid

switch to Irus Fluid find that it costs up to one-third less than other fire-resistant fluids—and its performance is comparable in every practical respect. This money-saving advantage is a vital consideration not only in the initial purchase price, but in reducing make-up loss expense.

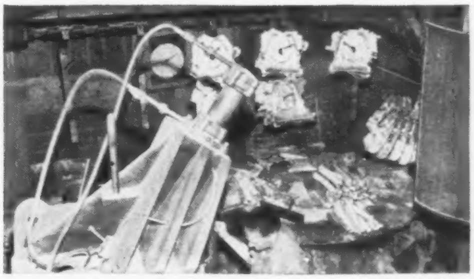
Irus Fluid 902 has other features, too:

1. It contains no corrosive ingredients and has shown no harmful effects on normal seals, fittings, or bearings . . . it will not promote rust.
2. No major equipment modification is necessary . . . simply clean your present fluid thoroughly from the system and replace with Irus Fluid.
3. Practical application proves it has exceptional viscosity and lubricating qualities . . . doesn't thin out in use.
4. The yellow color of Irus Fluid enables you to spot and trace leaks easily . . . a valuable benefit in preventive maintenance.

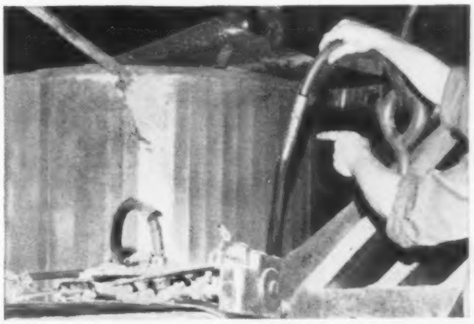
If your operation utilizes die-casting machines, plastic molding machines, glass blowing machines, permanent mold machines or any other hydraulic equipment where fire hazards are of concern, we suggest you investigate the advantages of Shell Irus Fluid 902.

Write or call the Shell Oil Company office nearest you.

*Trademark



Such specialized die-casting machines require a fire-resistant hydraulic fluid to assure maximum safety.



Finger points to line break in hydraulic cable that caused flash fire and machinery damage while operating with mineral oil type fluid.

SHELL OIL COMPANY

50 WEST 50TH STREET, NEW YORK 20, NEW YORK
100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL

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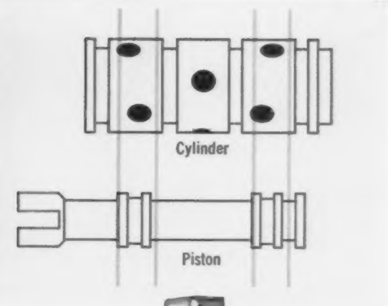
MATCH PISTON LANDS TO CYLINDER PORTS PRECISELY WITH SHEFFIELD'S MICRO-FORM GRINDER



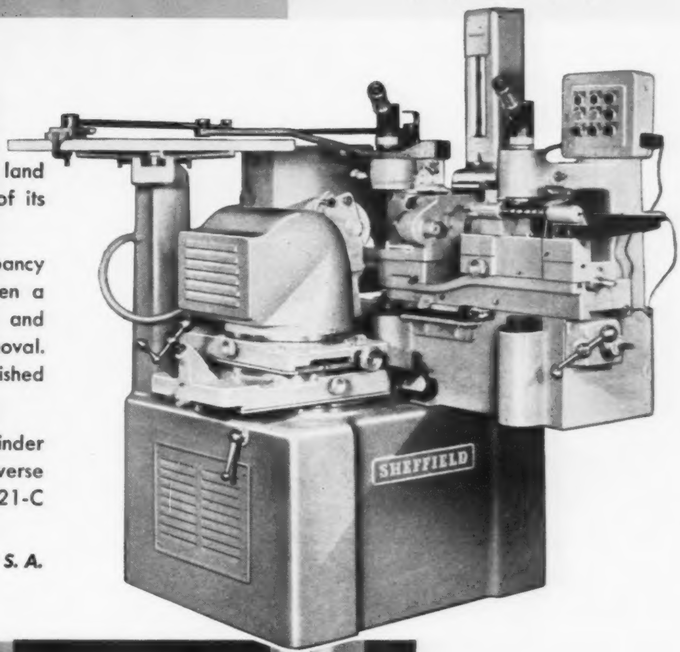
This servo cylinder and piston are typical of the very precisely machined hydraulic components in aircraft propeller and flight control systems.

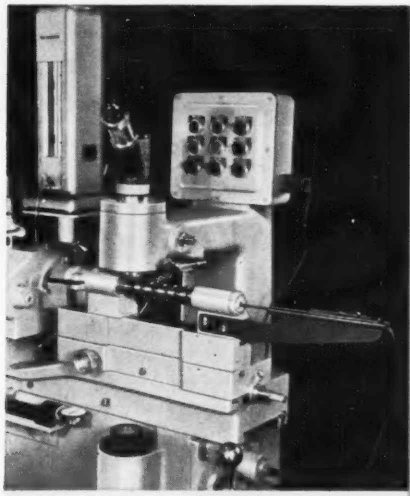
With the actual cylinder as a reference, each piston land is individually ground to match the inside edge of its respective cylinder port.

If a flow test then reveals the slightest discrepancy between land and port edge, the piston is given a finishing touch, using a Sheffield Precisionaire and Airetest Indicator to show progress in stock removal. Thus, the correction of the land face can be accomplished to within $\pm$ .000010".

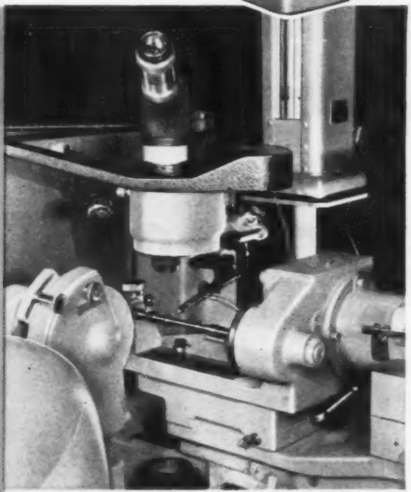
This is typical of the wide range of Micro-Form Grinder applications in duplicating precision profiles or reverse profiles from a master. Write for Bulletin MFG-121-C to Dept. 9.

THE SHEFFIELD CORPORATION, DAYTON 1, OHIO, U. S. A.





Cylinder under observation on auxiliary table.

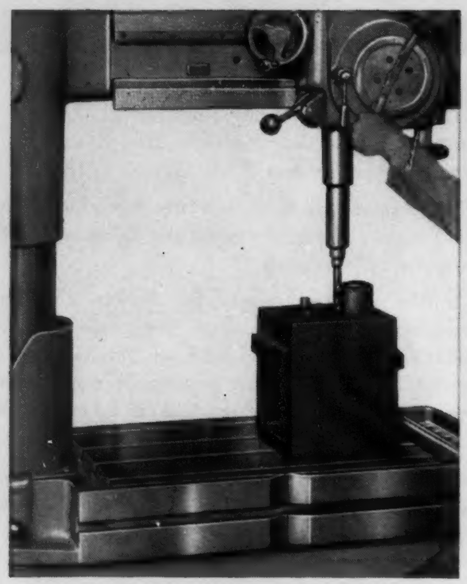


Airetest Indicator shows stock removal in final correction.

the SHEFFIELD corporation

manufacture and measurement for mankind

7560



SMALL WORK

BIGGER...

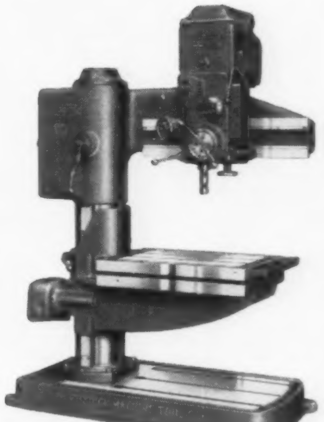
FOSDICK SENSITIVE RADIAL DRILLS

sensitive to your

We put a table on the radial to give you two machines in one—and a work size versatility that is unmatched in any drilling machine of comparable price and size!

Actually, the Fosdick Sensitive Radial combines the best features of two proven, reliable designs. The capacity and flexibility of a radial—the rigidity, compactness and convenience of an upright. For job shop work or production, it's the answer to useful capacity in limited floor space. Economically priced, too! The economy of first cost is second only to the economy of use.

STILL BIGGER



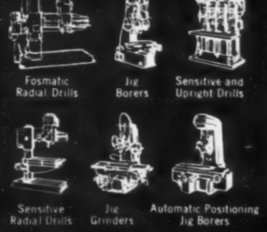
ALL THESE WORK SIZES ON ONE MACHINE—
The Fosdick Sensitive Radial Drill. Also available as a Layout Machine, which combines high precision compound table with sensitive radial drill.

work size problem...and your pocketbook

Ask for Bulletins SRA and LMA.

The arm of the Sensitive Radial swings 360° on the rigid one-piece column. Controls are always at the same convenient height. Work is placed on the adjustable table, or on the base with the table swung out of the way. Drills up to 2″ in cast iron. 12″ column, 3′ or 4′ arm, nine speeds (ranges from 60-1200 to 175-3500 rpm), four feeds (.004-.020 or .002-.010), 3 hp motor, reversing motor control for tapping.

Write today for complete information on the Fosdick Sensitive Radial Drill.



NEED DRILLING EQUIPMENT? GET A PROPOSAL FROM FOSDICK!

FOSDICK

THE FOSDICK MACHINE TOOL CO.
CINCINNATI 23, OHIO

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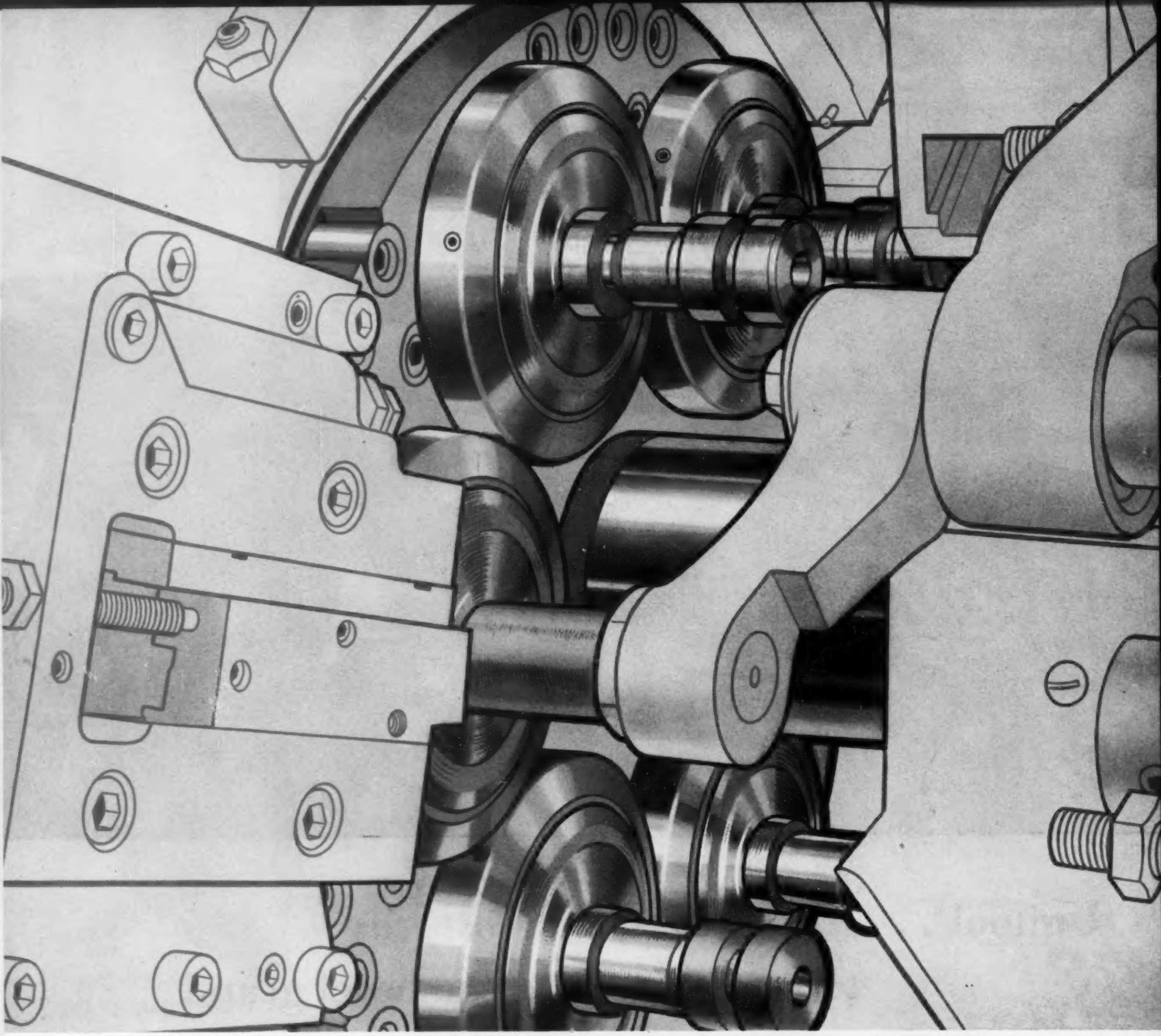
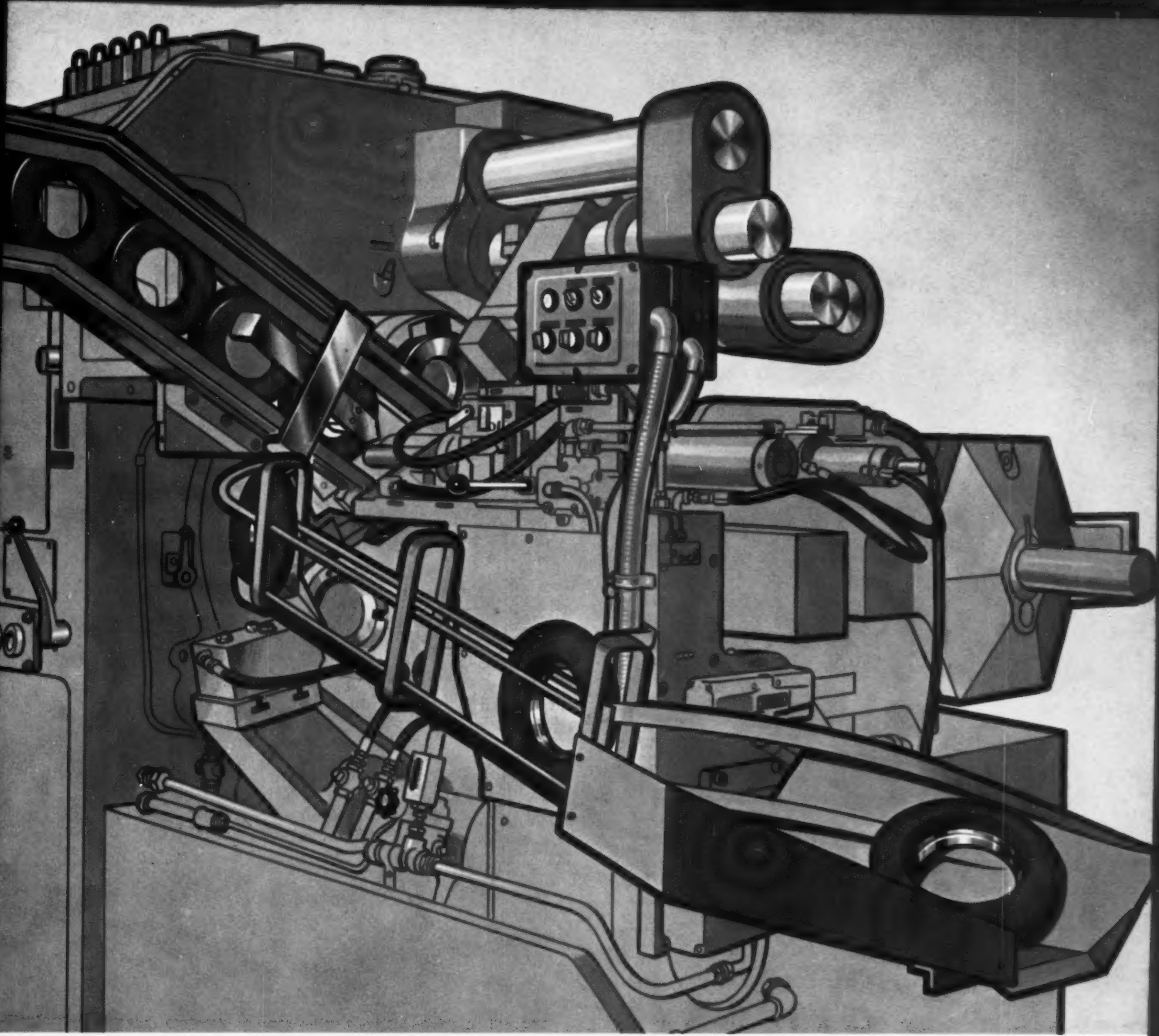


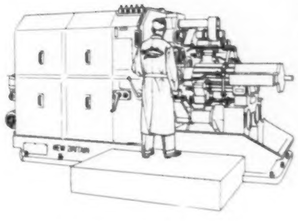


get more chucker work done with automatic "handling"

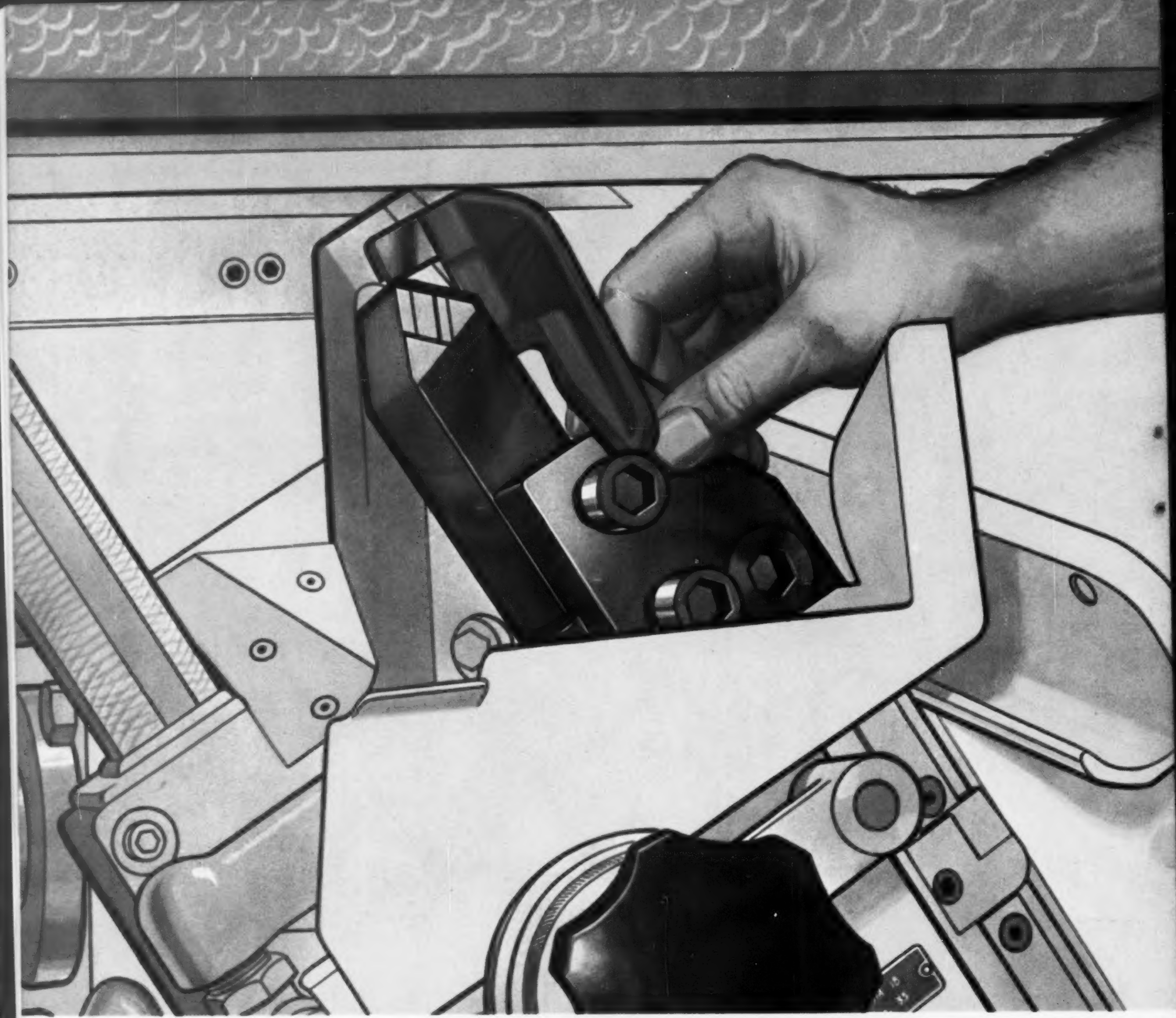
New Britain chuckers are the time-tested leaders in their field. Their basic open-end design, an exclusive New Britain feature, makes them unusually well adapted to the automatic handling of pieces. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

THE NEW BRITAIN MACHINE CO.

NB



Automatic Chucking Machine



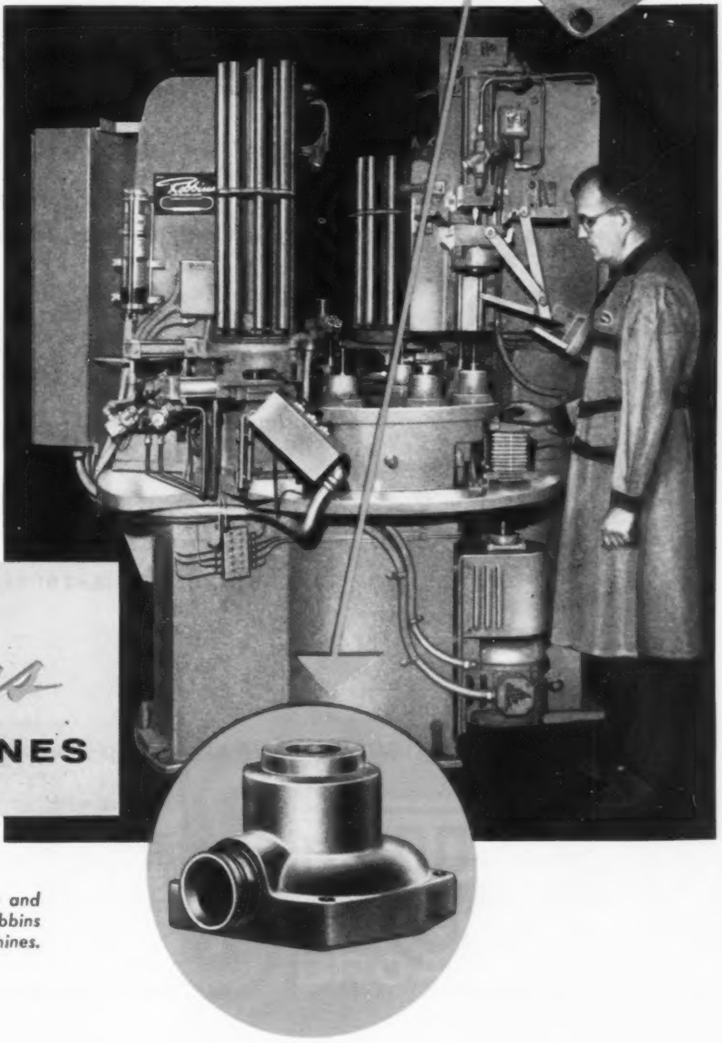
720 Assemblies Per Hour AUTOMATICALLY!

This Robbins "Assemblimatic" feeds, positions, assembles and unloads automatically . . . producing 720 four-piece assemblies every hour! It assembles a needle bearing, washer and seal in two sizes of a steering gear end cover. Parts are fed and positioned from indexing magazines, and completed assemblies are removed and placed on a conveyor . . . all automatically.

Machine features include: (1) Robbins panel, one-third standard size, with plug-in aircraft type relays and controls which prevent assembly unless parts are correctly positioned, (2) Index table with both barrel type cam and shot bolt for accuracy and magnetic operation of index and dwell, (3) Positive dwell time control through synchronous timer and electrical interlock at each station, (4) Hardened and ground ways, (5) Automatic lubrication, (6) Electrical and pneumatic equipment to J.I.C.

Robbins special assembly machines save manpower, speed production and improve quality, often combine machining with assembly for further savings. Automatic inspection, selection, orientation, assembly and in-process gaging assure consistent high quality production. Ask us for recommendations to help solve your automatic assembly or machining problem.

OMER E. ROBBINS COMPANY
24796 PLYMOUTH ROAD • DETROIT 39, MICH.

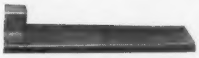


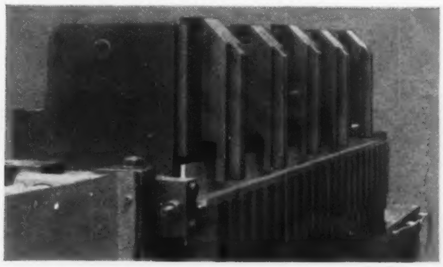
Robbins
SPECIAL MACHINES

New brochure describes and illustrates a variety of Robbins special assembly machines. Write for your copy.

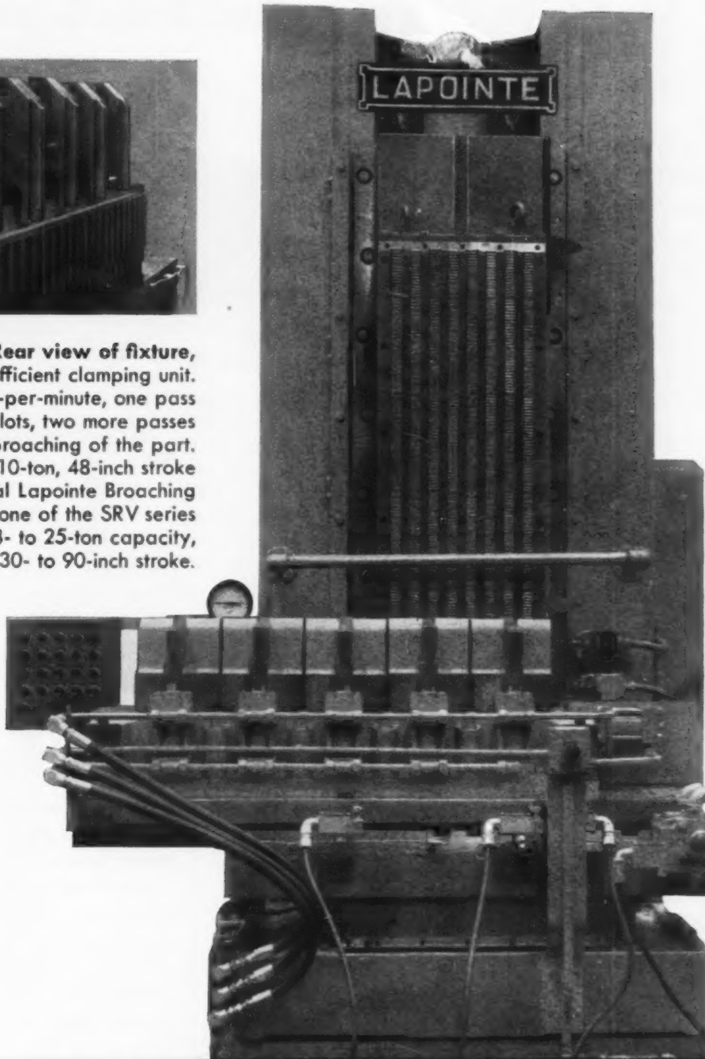
1280 slots per hour

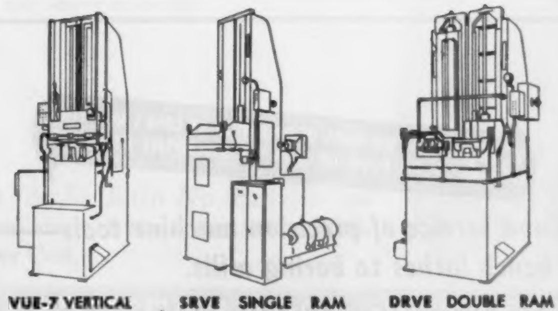
–BROACHING!





Rear view of fixture,
showing the efficient clamping unit.
Broaching at 60 feet-per-minute, one pass of ram broaches 8 slots, two more passes completing the broaching of the part. The machine is the 10-ton, 48-inch stroke Single Ram Vertical Lapointe Broaching Machine which is one of the SRV series ranging from 3- to 25-ton capacity, 30- to 90-inch stroke.





VUE-7 VERTICAL PULL-UP ELECTRIC | SRVE SINGLE RAM VERTICAL, ELECTRIC | DRVE DOUBLE RAM VERTICAL, ELECTRIC

LAPOINTE

known to be the best in
BROACHING

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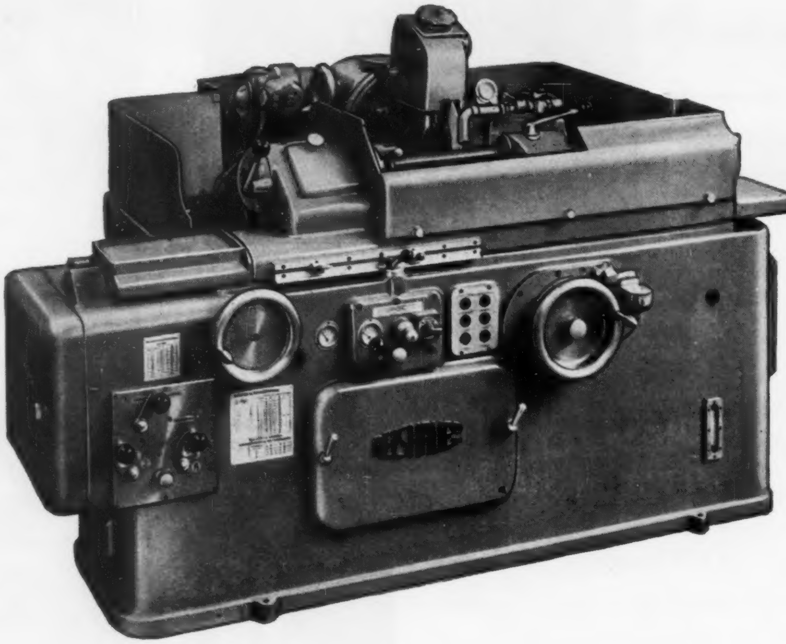
SWISS **REISHAUER** MADE

UNIVERSAL THREAD and WORM GRINDERS

For Production or Tool Room Grinding Operations



The Type NRK UNIVERSAL Thread and Worm Grinder is designed for grinding with single or multi-thread wheels. This machine, with attachments, can be used for grinding and relief-grinding of external—right- and left-hand—single or multiple screw threads—to any desired profile.

THE NRK GRINDS:

- **Thread Gauges**
- **Taps — all kinds — straight or spiral flutes**
- **Thread Milling Cutters**
- **Trapezoidal Thread Spindles**
- **Thread Chaser Dies for self-opening die heads**
- **Gear and Worm Hobs**
- **Cylindrical Press Rollers**
- **Thread Rolling Dies up to 8" diameter**
- **Crushers for forming multi-rip grinding wheels**
- **Commercial Threads — plunge cut method — on all kinds of screws, studs, spindles, etc.**
- **Internal Threads up to 5" diameter**
- **Racks up to 18" long**

CAPACITY AND SPEEDS

Admits work pieces between centers	28"
Maximum length of thread ground	17-½"
Minimum thread diameter	.120"
Maximum thread diameter	8"
Minimum pitch	60 t.p.i.
Maximum pitch	3"
Width of single thread grinding wheel	.32"
Widths of multi-thread grinding wheel	.8"-1.2"-1.6"
Speeds of grinding wheel	1550 or 1900 r.p.m.
Speeds of work spindle	1.6 to 80 r.p.m.

SEE THESE MACHINES IN OPERATION AT COSA'S NEW YORK SHOW ROOM OR SEND FOR DESCRIPTIVE LITERATURE.

COSA *—nationwide sales and service of precision machine tools —from bench lathes to boring mills.*

COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

IN CANADA Contact COSA CORPORATION of CANADA, Ltd., 1160 Lakeshore Road, Long Branch, Toronto 14, Ontario

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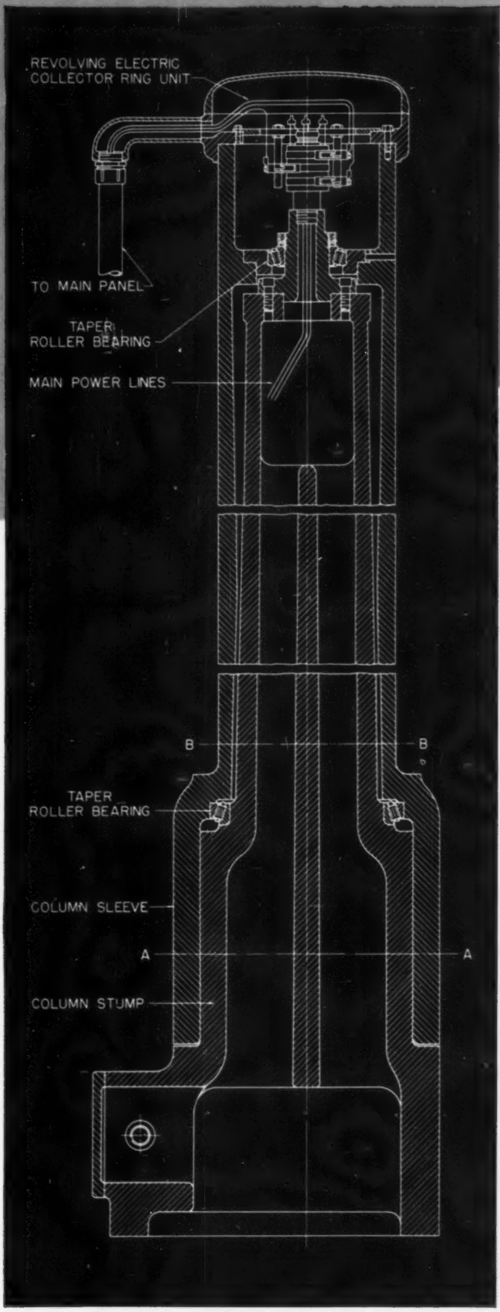


New thrust resistant, "TIMKEN" mounted column and sleeve assembly.

Rigidity Increased

50%

The new "TIMKEN" mounting of the column and sleeve on the new model 32-speed Hole Wizard Radial has hit the "jack-pot" for rigidity. It's the stiffest, most resistant column unit we've ever known.

Under drilling tests up to 30 horse power deflection has been cut in half over former models. It's truly a marvel of rigidity.

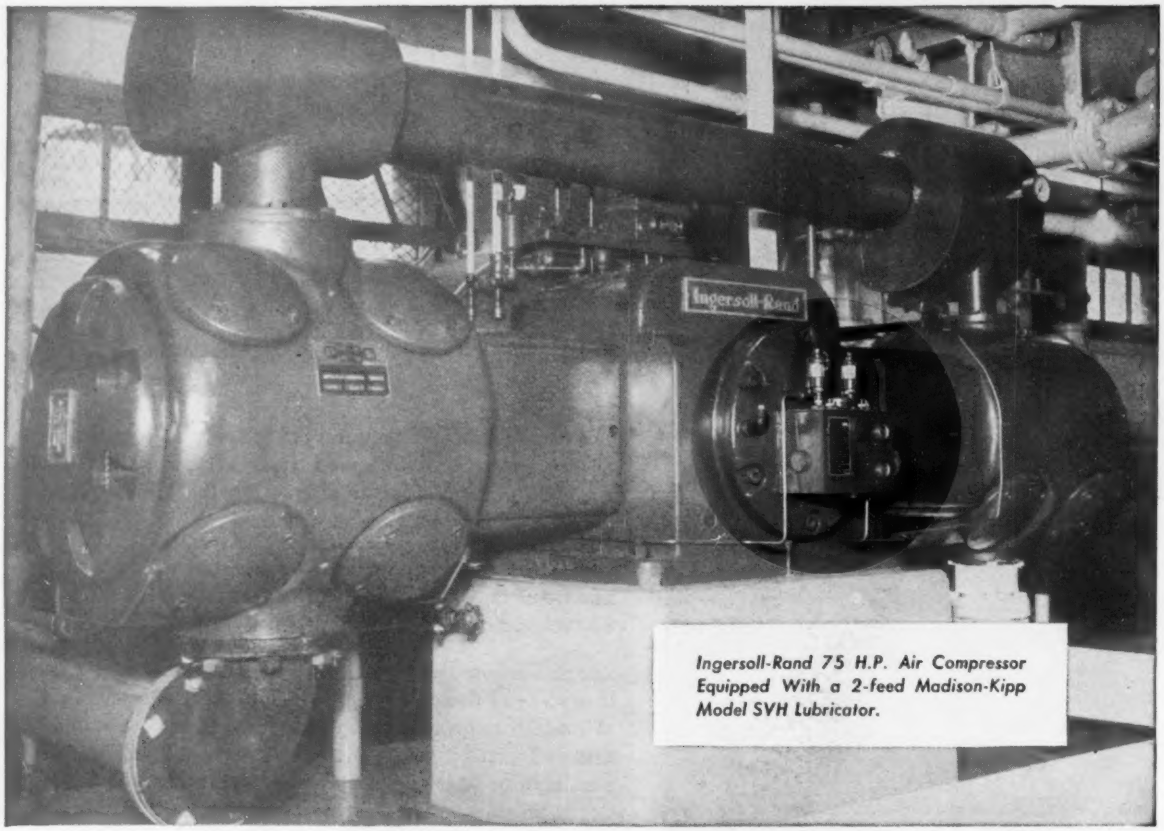
Large Timken bearings at top and bottom when preloaded bind the column and sleeve into the equivalent of a solid unit for resisting functional stresses and cuts arm deflection to an absolute minimum. This definitely results in greater accuracy and longer cutting tool life. To further increase resistance to stresses the column sleeve departs from conventional design by employing a tapered inner wall providing an unusually heavy section where the greatest functional stresses are concentrated.

A new "NON-CREEP" clamping mechanism in combination with a solid column sleeve cuff adds greatly to the rigidity of this new "AMERICAN" Radial.

Write for Bulletin No. 328 for the complete story of More and Better Work at Lower Cost.

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS



Ingersoll-Rand 75 H.P. Air Compressor Equipped With a 2-feed Madison-Kipp Model SVH Lubricator.

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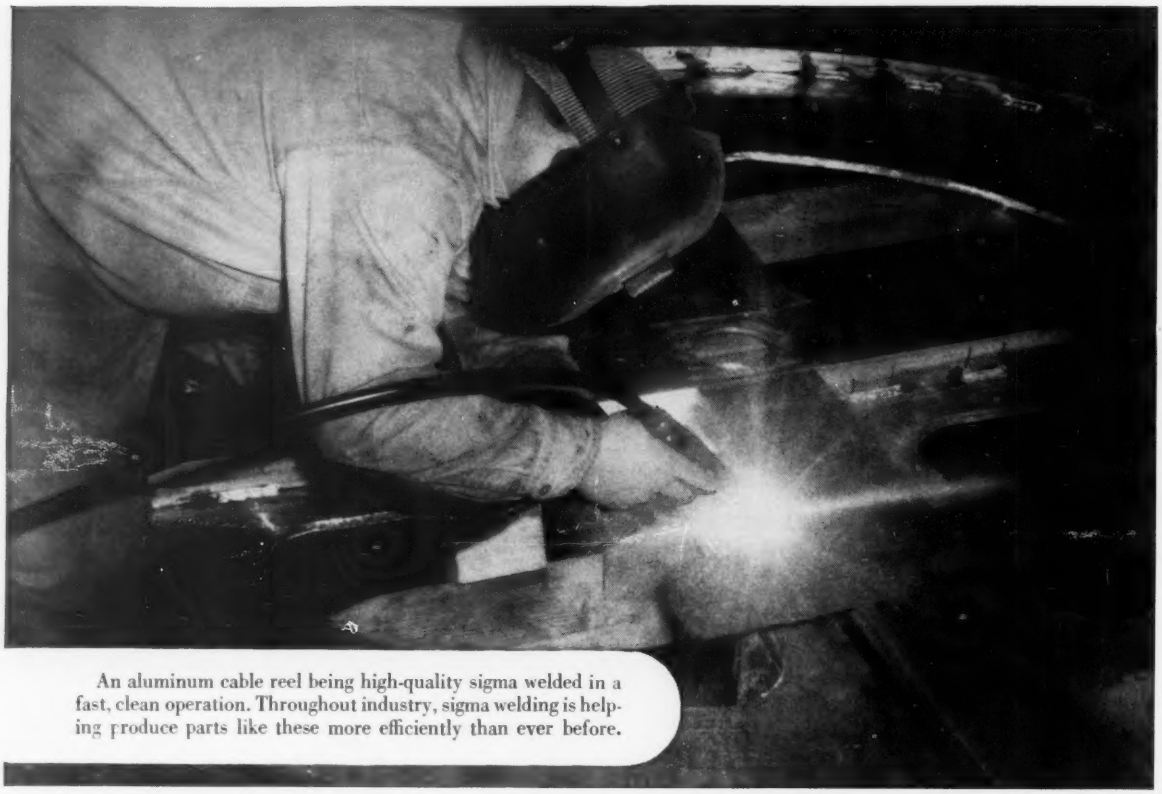

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Take it from the early birds...

"IT'S THE GREATEST

Niagara Series E 4½ OBI Press in operation at a well known eastern commercial stamping plant. Work includes stamping small wrenches; trimming canopies for electrical fixtures; piercing, cutting off and forming saddles with a progressive die (shown).

Niagara Series E 4½ OBI Press engaged in blanking and drawing of kitchen cannister lids from half-hard aluminum at midwestern housewares manufacturing plant.

"we can produce from 8,000 to 10,000 pieces in an eight hour day"

"much safer press"

"takes less floor space"

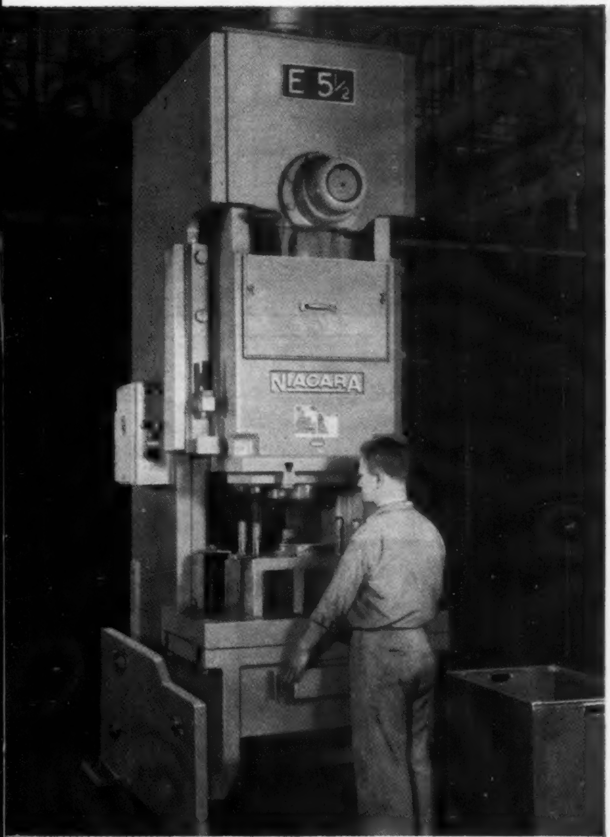
"has a centralized pressure lubricator which we like very much"

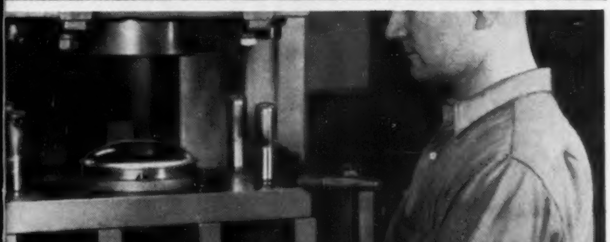
O.B.I. EVER BUILT"

"we find that dies without posts work much better on this press"

"all dies give better and longer runs"

"large slide area for large trimming, blanking and progressive dies"





Niagara Series E 5½ OBI Press forming and trimming hemispherical copper parts for one of the "Big Two" electrical manufacturers.

Few developments in metalworking history have drawn the enthusiastic endorsement given Niagara's revolutionary Front-to-Back Crankshaft OBI Press.

Now, as at the 1955 Machine Tool Show where it was unveiled, there is *nothing* even remotely resembling it in the industry ... design-wise and production-wise.

Customers in U.S. and Canada ... the "early birds" who are doing their modernizing with the most modern press of all ... can today tell you about accomplishments with this newest and greatest of OBIs that you would have never dreamed possible. Yes, the press that Niagara conceived to do more than any OBI ever built is doing just that for a fast-growing list of metalworking plants.

There's a huge fund of successful experiences that a Niagara representative can share with you today. Draw on it now and utilize it in your modernization plans. Make a date, at your convenience, for a personal call.

... and if you haven't received new Bulletin 56 with complete design description and specifications (75-200 ton capacities, 4½-7½ inch shaft diameters, standard and automated models) write for your copy at once. You will find it invaluable to your planning.

NIAGARA MACHINE & TOOL WORKS • BUFFALO 11, N.Y.

DISTRICT OFFICES:

Buffalo • Cleveland • Detroit • Indianapolis • New York • Philadelphia

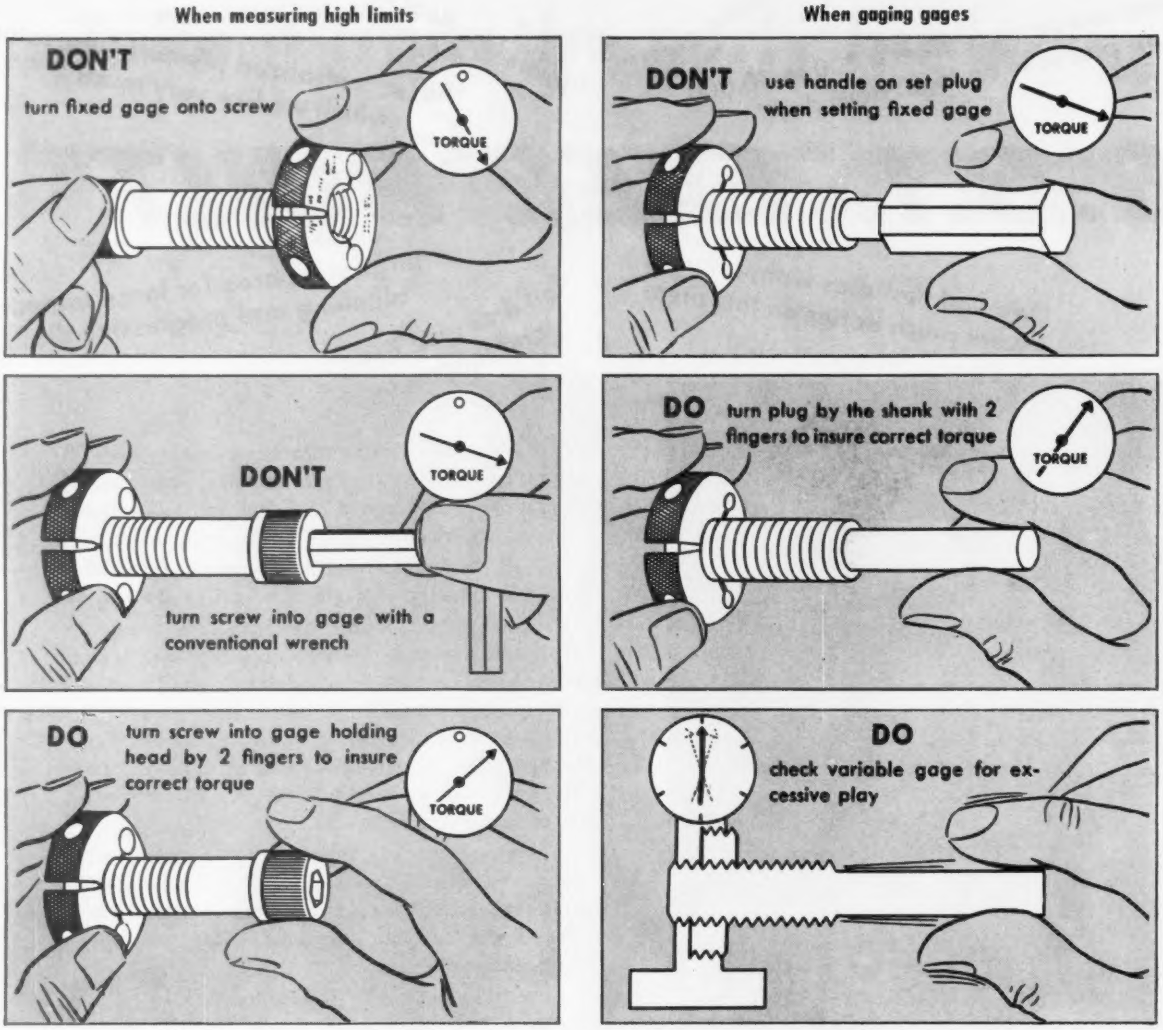
Distributors in principal U. S. cities and major foreign countries

America's most complete line of presses, press brakes, shears, other machines and tools for plate and sheet metal work

NIAGARA

front-to-back crankshaft

INCLINABLE PRESSES



These illustrations from new SPS booklet show some of the do's and don'ts of gaging precision threads.

3A threads: what they are; how to gage them—new SPS booklet tells all

Threads made to Class 3A fit are the most precise in general use in industry. But you do not always get the 3A precision you specify. Because of many different gaging techniques that yield varying results, screws with threads well outside the Class 3A tolerance limits often pass inspection.

SPS has prepared a new booklet on this subject. It explains clearly what Class 3A threads are and the pros and cons involved in the widely varying gaging techniques in use today. It reviews the gaging of high and low limits of 3A threads, sampling techniques, and even the methods of gaging gages.

All standard UNBRAKO socket screw products fall within specified tolerance limits *no matter what method is used to gage them.* Leading industrial distributors carry complete stocks. Unbrako Socket Screw Division, STANDARD PRESSED STEEL Co., Jenkintown 19, Pa.

Form 2239, "Class 3A Threads: what they are; how to gage them." 16 pages, with many illustrations. Write for free copy today.

STANDARD PRESSED STEEL CO.

UNBRAKO SOCKET SCREW DIVISION SPS

JENKINTOWN PENNSYLVANIA

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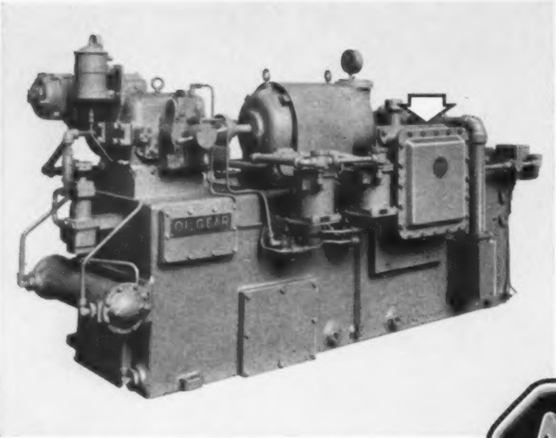
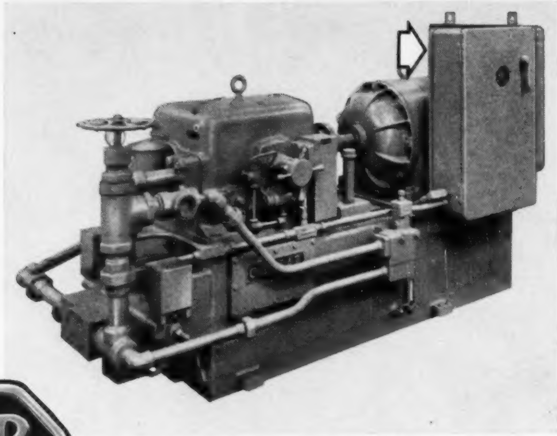
Tear this chart out and preserve it

YOUR GUIDE TO COLUMBIA WATER HARDENING TOOL STEEL GRADES

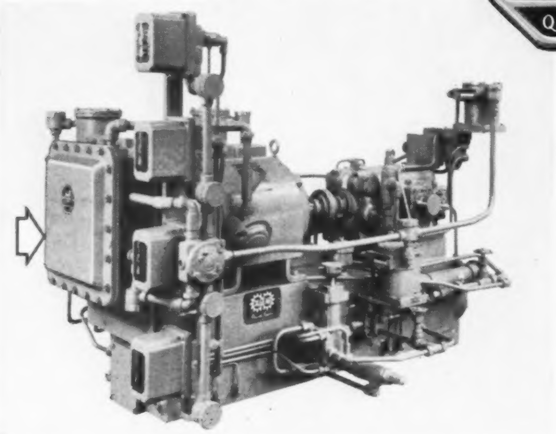
TYPE AND GRADES	DESCRIPTION	HARDENING RANGE	QUENCH	TEMPERING RANGE	USEFUL HARDNESS
W1 Grade 1 Columbia SPECIAL	Best quality water hardening tool steel — meets all metallurgical tests	1420° F. to 1530° F.	Water and Brine	350° F. to 500° F.	67/59 Rc
W2 Grade 2 VANADIUM EXTRA	Vanadium treated modification of Columbia EXTRA, fine grained, tough, long wearing carbon tool steel	1425° F. to 1500° F.	Water and Brine	350° F. to 500° F.	64/58 Rc
W5 Grade 2 WATERDIE EXTRA	Chromium alloyed Columbia EXTRA for increasing depth of hardness and wear properties	1475° F. to 1525° F.	Water and Brine	350° F. to 500° F.	65/56 Rc
W1 Grade 2 Columbia EXTRA	Extra quality straight carbon tool steel — meets hot-etch and hardenability tests, wide range of uses	1420° F. to 1550° F.	Water and Brine	350° F. to 550° F.	65/57 Rc
W1 Grade 2 Columbia EXTRA HEADERDIE	Selected carbon with controlled hardenability to meet severe physical requirements of cold heading Metallurgically controlled for center soundness	1470° F. to 1550° F.	Water and Brine	400° F. to 530° F.	63/58 Rc
W2 Grade 3 VANADIUM STANDARD	Vanadium treated Columbia STANDARD — a shallow hardening fine grained tool steel for general purposes	1420° F. to 1470° F.	Water and Brine	400° F. to 550° F.	63/56 Rc
W1 Grade 3 Columbia STANDARD	A good quality reliable straight carbon, general purpose tool steel for short run tools not requiring the high physical properties	1420° F. to 1470° F.	Water and Brine	400° F. to 550° F.	63/56 Rc



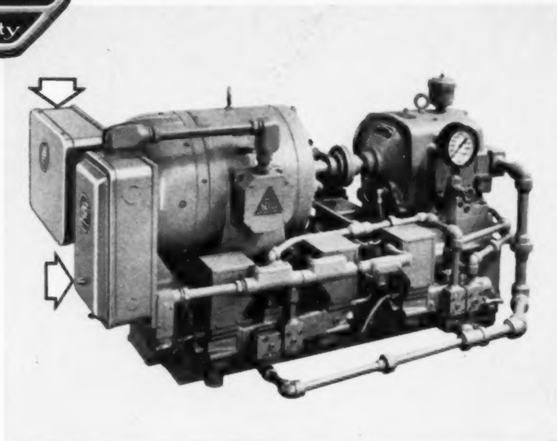
Oilgear Type DXE-825 2-way variable delivery pump for large Cordite press. Allen-Bradley motor controls in Type 7 explosion-proof bolted enclosure.



Oilgear Type DR-3511 1-way variable delivery pump for fluid power to gun gymnasticater. Allen-Bradley motor controls in Type 1 general-purpose enclosure.



Oilgear Type DXG-425 duplex pump for fluid power to large Cordite extrusion press. Allen-Bradley motor controls in Type 7 explosion-proof bolted enclosure.



Oilgear Type DS-825 1-way variable delivery pump for fluid power to machine tool. Allen-Bradley motor controls mounted in Type 1 general-purpose enclosure.

OILGEAR FLUID POWER PUMPS
...use Allen-Bradley Motor Controls

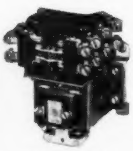
The four powerful oil pumps shown above, and built by The Oilgear Company for delivering fluid power to large extrusion presses and other hydraulic machinery, are factory-equipped with Allen-Bradley solenoid motor starters. The enclosures used are determined by the conditions existing where the pumps are installed.

Why is Allen-Bradley control so popular with machinery builders? The answer is found in the solenoid design. Its one moving part is a virtual guarantee of millions of trouble free operations.

In addition, the double break, silver alloy contacts—used throughout the Allen-Bradley line—eliminate all need of maintaining contacts—they are always in perfect operating condition. Where bolted enclosures are used, maintaining contacts becomes a costly, time-robbing job.

Another outstanding advantage is the protection afforded by the accurate and reliable overload relays. Being solder pot relays, they do not deteriorate with age —they remain accurate and reliable.

Send for a copy of the Allen-Bradley Handy Catalog . . . a good reference manual on motor controls . . . manual and automatic. Write for your copy, today.



Bulletin 700 relay for machine tools.

Bulletin 709 solenoid starter removed from enclosure to show arc hood and two overload relays. Available up to 300 hp, 220 v; 600 hp, 440-550 v.

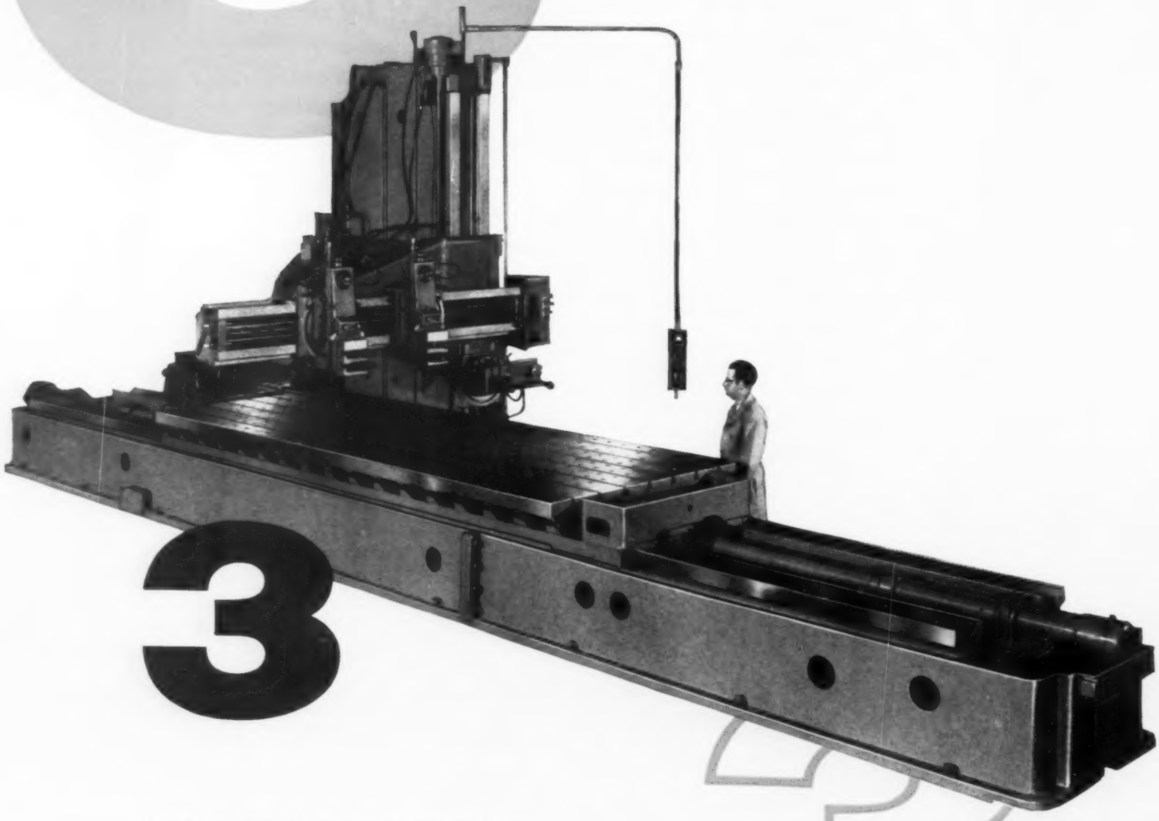
Allen-Bradley Co.
1331 S. First St.
Milwaukee 4, Wis.

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY

In Canada—
Allen Bradley Canada Ltd.
Galt, Ont.

For more information fill in page number on Inquiry Card, on page 259

3 planers in one machine



3

Pendant control of range and cutting speed selection.

Maximum return speed regardless of cutting speed.

Quick reversals with minimum overtravel.

TRANSMISSION EXTENSION

with hydraulic triple circuit

h3 drive

low speeds to 100 fpm. with force for heavy cuts
medium speeds to 150 fpm. with force for normal cuts
high speeds to 300 fpm. with force for light cuts

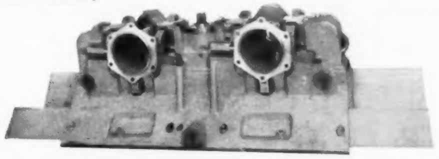
H3 drive is an exclusive new feature on Rockford Hydraulic Planers. In the three speed circuit, a double acting cylinder opposed by a single acting cylinder are employed, giving three speed ranges with the power inversely proportional. The hydraulic triple circuit provides the correct speed and force—in one machine—to most economically machine every type of metal. Ask a Rockford Machine Tool Co. representative for further information, or write direct.

ROCKFORD MACHINE TOOL CO.
2500 KISHWAUKEE STREET • ROCKFORD, ILLINOIS

h3 drive

FROM ROUGH CASTING TO FINISHED PART

Transmission extension housings are finish machined in automatic cycle from rough casting to finished workpiece. After rapid washing and final inspection, the part is ready for assembly.



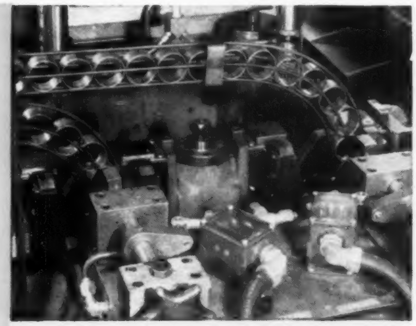
View of workpieces in special transfer plate fixture. Both housings are located and accurately positioned by means of dowels and screw-operated V-block clamps.

ON

W. F. & JOHN BARNES SPECIAL 10-STATION PROGRESS-THRU MACHINE

Here is another typical example of how W. F. & John Barnes Six-Point Machine Tool Building Service has helped increase production efficiency for a leading automobile manufacturer. All machining operations on transmission extension housings are now combined in one Special Barnes 10-Station Progress-Thru Machine at a production rate of 150 pieces per hour. Two operators, one at the loading end and the second at the unloading end, load and unload housings on transfer plates which carry workpieces through the entire machining cycle. Operations include boring, facing, milling, drilling, reaming, automatic press-in of babbitt bushings, and combination finish bore babbitt bushing and finish counterbore housing.

Whether your production requires large or small machines, you'll find the coordinated services at Barnes can help you solve problems quickly and efficiently.



Closeup of station seven where babbitt bushings are automatically pressed-in to the small end of the housings. Bushings are hopper loaded by operator at the unloading station.

BARNES' COORDINATED 6-POINT MACHINE TOOL BUILDING SERVICE INCLUDES:

1 **SPECIALIZED MANUFACTURING FACILITIES**—75-year background, large well equipped plant efficiently tooled to build high production machines.

2 **SPECIAL HYDRAULIC EQUIPMENT**—designed and built to meet JIC standards. Individually engineered units assure smooth, dependable actuation for every requirement.

3 **SPECIAL ELECTRICAL EQUIPMENT and CONTROLS** — individually designed and built for maximum safety and ease of control, with circuits that assure the most dependable coordination of all machine functions.

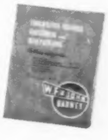
4 **SPECIAL GAUGES, FIXTURES, TOOLS**—designed for each individual machining problem, assure accuracy of operations at high production speeds.

5 **SPECIAL HANDLING AND CONVEYOR EQUIPMENT** — designed and built to reduce work handling, effect maximum safety and efficiency.

6 **COORDINATED DESIGN AND ENGINEERING**—Mechanical, Hydraulic, Electrical, Process, Tool, and Fixture Engineers work together at Barnes. Team-work solves complex problems quickly.

WRITE FOR FREE BOOKLET

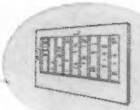
Ask for free booklet "Coordinated Machine Engineering" describing the scope of Barnes machine tool building service.



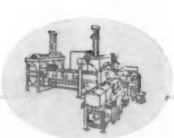
W. F. & JOHN BARNES COMPANY

MACHINE TOOL DIVISION

402 SOUTH WATER STREET, ROCKFORD, ILLINOIS



Special Electrical Controls



Food Machinery

AUTOMATIC PROGRESS-THRU AND TRANSFER TYPE MACHINES

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

"Engineered Production" Service

FOR BROACHING

It takes all 3

American's "*Engineered Production*" Service . . . gives the broach-user the complete three-part service that is essential to obtain the most practical broaching method. Years of design and production engineering experience, unavailable at any price, are effectively added to your staff at no extra cost.

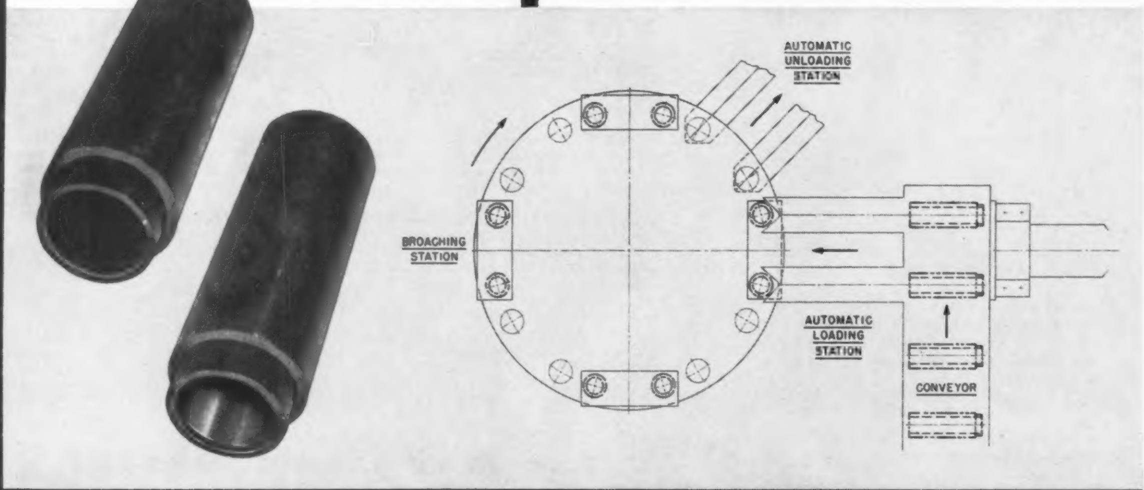
THE JOB — Broaching the I.D. of transmission brake sleeve parts, two at a time, in a fully automatic cycle with a high production rate required.

THE RESULT— 300 completed parts per hour in an electrically controlled and interlocked automatic cycle.

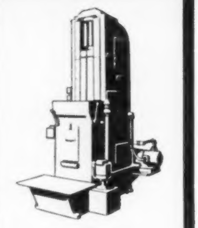
1

PROPER BROACH TOOL DESIGN

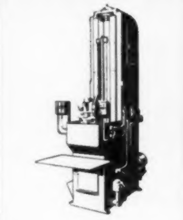
Top-quality results on any broaching operation require starting the job with design of the broaching tool itself. In solving this all important first step, American Broach considers stock removal, length and width of cut, finish tolerances required, etc. High-quality work and long tool life result because broach and machine are designed to operate as a team. In this installation the two broaches move downward simultaneously during the cutting stroke. Next, the table indexes and the two broaches are returned to retriever automatically for return to starting position for the next broaching cycle.



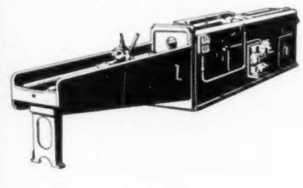
Broaching Tools



Three Way



Single Ram



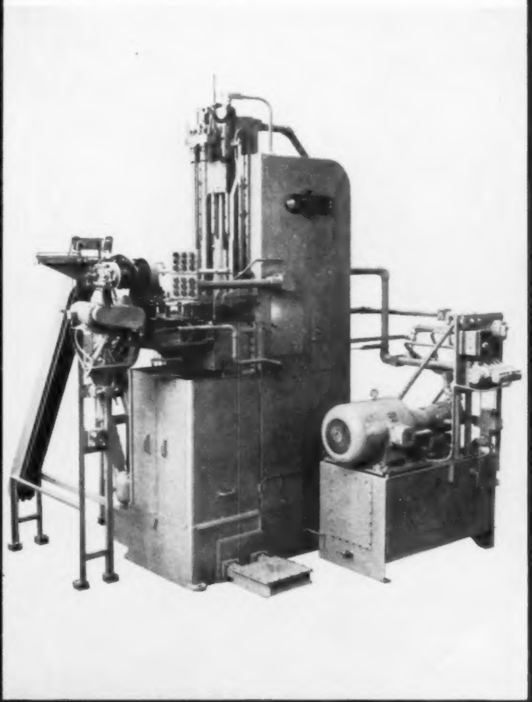
Horizontal

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

to give you peak broaching performance

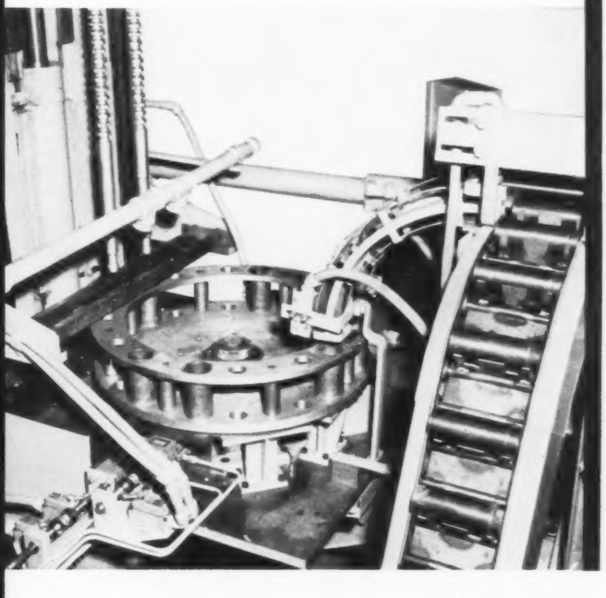
2 SPECIFYING THE RIGHT MACHINE

Production rate required, length and speed of stroke, relationship to other production machinery, available floor space, etc. determine the selection of the broaching machine capable of doing the best job. At American, machine selection follows design of the broaching tool. This vertical hydraulic internal pull-down machine is provided with separate hydraulic circuits for machine operation and index unit. Part elevator is motor-driven, uses air cylinder for parts loading.

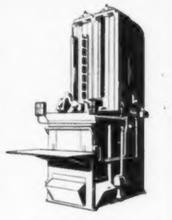


3 EFFICIENT FIXTURING

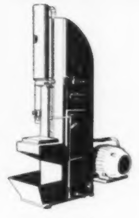
Whatever your parts geometry or hourly needs, fixturing by American Broach forms the vital third link in the production chain. As shown in the close-up, two parts are loaded at a time in the eight-station dial type indexing fixture. Discharge is automatic as parts ride off skid plate and drop into discharge chute. This installation is another example of how "skills" built into the tool, machine, and fixtures make sure that production schedules can be maintained even with inexperienced operators.



Get more facts in American's Pull-Down Bulletin A616. Write for your free copy today.



Duplex Ram



Presses

American

SUNDSTRAND

BROACH & MACHINE DIVISION

SUNDSTRAND MACHINE TOOL COMPANY

ROCKFORD, ILLINOIS

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

These MATTISON "GIANTS" make surface

1 Here is the *all-new Mattison Plano Surface Grinder*, which gives you extreme accuracies at all positions on the table (up to 60 in. wide) for precision-grinding large die plates, machine tool ways, and aircraft industry dies. To achieve maximum accuracy, the main support for the cross rail has been centered in the heavy ways on two sides of the main upright. Complete pendant control is provided for all machine functions. Hydraulic power provides both traversing or jump feed in increments ranging from ½ to 4 in. For grinding shoulders, micrometer cross-feed in increments of .001 or .002 can also be set at the pendant. Vertical feed can be set in increments of .001, .002, or .0002 and actuated by pushbutton or automatically.

2 **Model 900SS Face Grinder** is designed to pull 150 hp through the 48 in. segmental wheel (8 x 3 in. face), and is capable of withstanding 100 per cent overloads for brief periods in taking roughing cuts up to ¼ of an inch on the high spots of castings. Horizontal or vertical magnetic chucks assure positive holding and quick positioning of large pieces machined in a series of fast, *big* cuts.

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

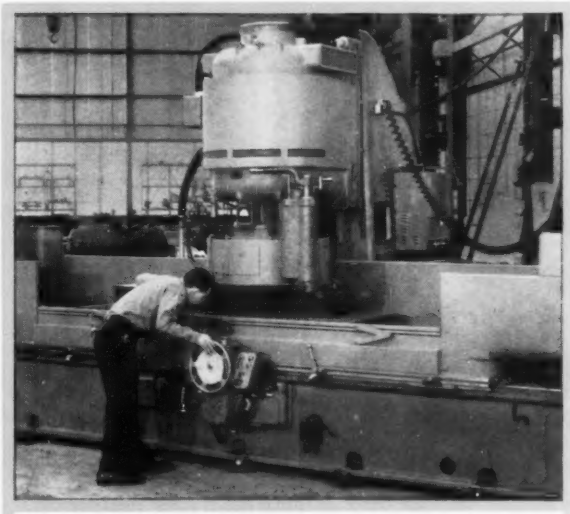
with stepped-up horsepower grinding more profitable!

NOW . . . MACHINE LESS METAL, SPEED LOADING AND UNLOADING, CUT THROUGH TOUGH SCALE FAST AND EASY

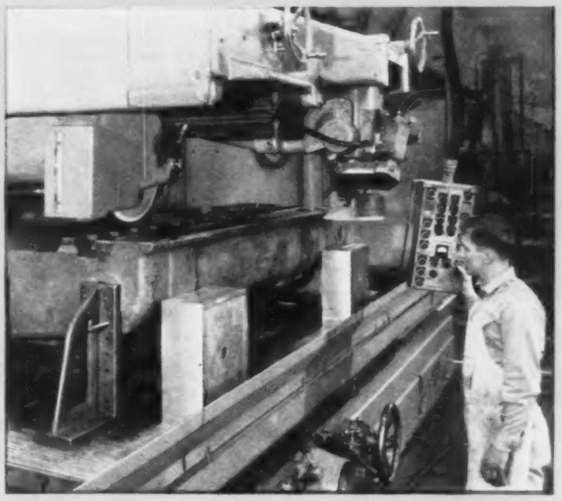
These Mattison machines combine large size with tremendous horsepower not usually associated with grinding, and make possible major savings in machine time and time of skilled operators. Now, large pieces can be set up on magnetic chucks and ground in less time than it ordinarily takes to locate them and clamp them in a fixture. You can reduce the weight of large castings and minimize the amount of metal being removed because stock allowances need not be as great. On large production runs, material costs can be reduced substantially.

Think of what these grinders mean in terms of tool life and efficiency when machining tough forgings and castings from the rough. They take these cuts in stride, getting under scale and removing a sizable amount of stock in a single pass. Hard spots have little effect on the wheel. Accuracy goes up, too. Large, uninterrupted surfaces can be ground using minimum wheel clearance—finishing cuts can be taken with wheels set dead flat. Hardened ways can be ground to a flatness of split thousandths, and results compare favorably with the finest hand scraping. Hardened surfaces that cannot be scraped are ground easily.

Call your Mattison dealer and arrange to have sample parts ground in the Mattison Methods Laboratory.



3 **400SS Vertical Spindle Surface Grinder,** with 100 hp spindle motor, is designed for fast stock removal and precision production of elongated parts or full chuck loads of smaller castings. Extreme accuracy is possible because the table never overhangs the bed. Magnetic chuck enables parts to be positioned or released without time-consuming handling of bolts, clamps, etc.



4 **Combination Way and Surface Grinder** brings you a faster, more precise method for machining several surfaces in different planes in a single setup. Unique three-column design provides rigid support for the two spindles. You can take a variety of cuts, such as dovetails, contours, etc., holding accurate alignment between surfaces. All machine motions are easily controlled from the pendant.

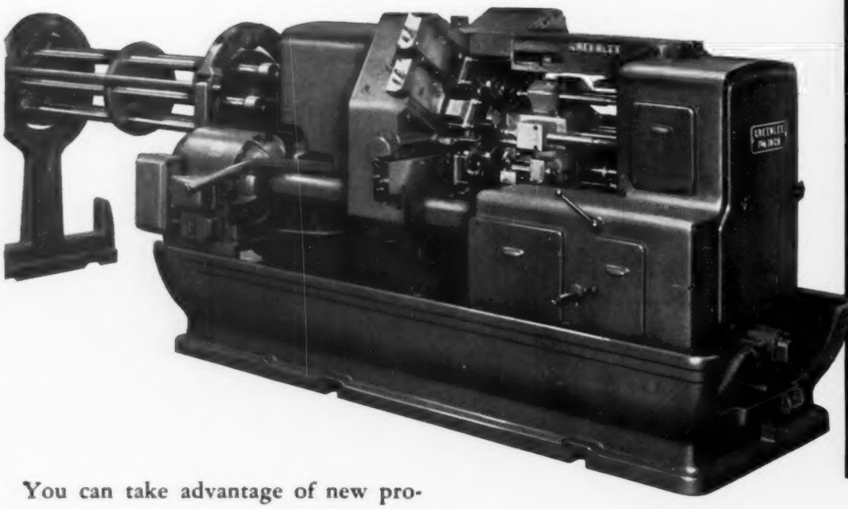
MATTISON
MACHINE WORKS
ROCKFORD ILL. U.S.A.

HIGH-POWERED PRECISION SURFACE GRINDERS

If it's a flat surface, there's a Mattison grinder to "machine" it!

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

now... greater accuracy, faster production



WITH GREENLEE SIX-SPINDLE AUTOMATICS

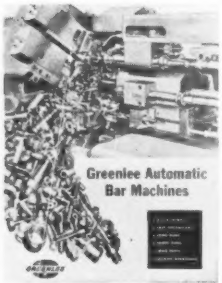
You can take advantage of new production techniques...attain higher levels of efficiency with the improved Greenlee 6-Spindle Bar Automatic. Its advanced design opens the door to some real profit opportunities. ● These design improvements are fully described in a catalog recently issued. Let us send you a copy today. Find out how Greenlee Automatics can save time and money in your plant. It will pay you to investigate.

IMPROVED SPINDLE CONSTRUCTION

The spindle has been completely redesigned to assure greater accuracy at higher speeds. True running . . . the new Greenlee spindle has five widely spaced, preloaded, angular-contact, precision ball bearings. Entire spindle is dynamically balanced for smooth operation. Metallic seals, labyrinth and friction washers with line contact provide maximum heat dissipation.

INCREASED SPEED

Spindle speed range has been increased. Enables you to take full advantage of the top efficiency and peak performance which carbide and high-speed tooling offer. Reduces down-time losses and tool costs.



WRITE FOR CATALOG No. A405

GREENLEE

GREENLEE BROS. & CO.
1867 Mason Avenue
Rockford, Illinois

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

You get

top value per dollar

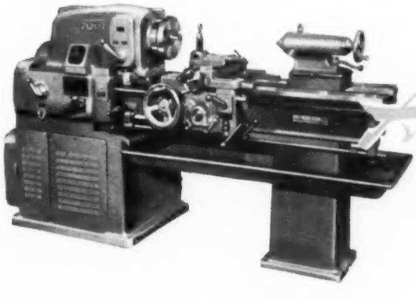
with a Hendey No. 2E Lathe

timesaving controls step up efficiency of toolroom or production turning!

Because all controls were designed with the operator in mind, the Hendey No. 2-E general-purpose lathe today is setting new standards of efficiency on both toolroom and production jobs. Two outstanding features are the electronic drive that permits infinitely variable speed control, and the instantaneous dynamic brake for rapid stopping and reversing of the spindle.

Here are more Hendey "top-value" features you'll want to check further: quick-change gearbox providing 48 changes of threads without changing gears; thread-chasing dial for returning carriage to the same thread groove; quick-change gearbox for 48 changes of feed without gear change; pushbutton energizing of main motor; and *two* control levers, permitting operator to start, stop, or reverse the spindle from any working position. Contact your nearby Hendey dealer for complete details and specifications.

for precision with production, buy Hendey



Hendey **machine division**

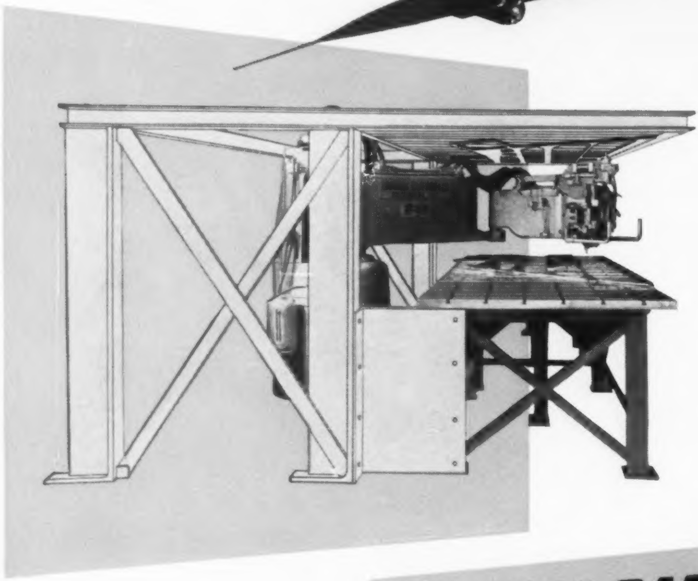
BARBER-COLMAN COMPANY

72 Loomis St., Rockford, Illinois

BARBER COLMAN ®

THIS IS THE "HUSTLER..."

CONVAIR B-58 SUPERSONIC BOMBER



...AND

HERE'S A

HUSTLER,

TOO!

EKSTROM, CARLSON

RADIAL-ARM DEPTH AND CONTOUR MILL

Here is the *fastest* and *most economical* machine you can buy for profile and contour work — a manually-operated, radial-arm mill. Outstanding performance results from daring, up-to-date design based on solid machine tool standards and a long-time knowledge of high-speed cutting. If you are interested in low initial cost, low maintenance, and high production capacity, let us tell you more about our No. 480 Mill. (*It is being used for producing important parts of the B-58.*)

ECCO

EKSTROM, CARLSON & CO.
1400 Railroad Ave., Rockford, Ill.

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

NEW DESIGN

in HONING TOOLS provides

improved wear characteristics

greater abrasive support

for bores up to 4″

This new BarnesdriL Honing Tool design means more efficient honing operations because it supplies better abrasive wear characteristics and greater strength at the point of cutting. The tool has very few parts in its simple construction, and may be designed for use with either a floating or rigid fixture. BarnesdriL wing-type abrasive stones are press-fit between standard hardened inserts which act as side supports for the stones as well as guides in the bore. Fiber jackets reduce stone wear by protecting the inserts against the abrasive and serve to hold the wing-type stones firmly in place.

Fully protected by patents, this new honing tool will improve your honing operations and reduce honing tool costs on honing operations. See your BarnesdriL representative, or send us prints of your honing operations for recommendation.

few parts

quick-loading

simple construction

low tool maintenance

easy stone-replacement

50th year

BARNES DRILL CO.

820 CHESTNUT STREET • ROCKFORD, ILLINOIS
DETROIT OFFICE: 3419 South Telegraph Road

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

NEW

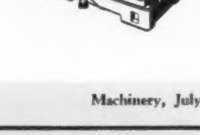
SUNDSTRAND VERTICAL TRACER RIGIDMIL PROVIDES 3-DIMENSIONAL CONTROL

Power and rigidity of the new Sundstrand Vertical Tracer Rigidmil make it ideal for taking irregularly shaped cuts in either ferrous or nonferrous metals.

AUTOMATIC LATHES | SIMPLEX RIGIDMILS | DUPLEX RIGIDMILS

SUNDSTRAND "Engineered Production Service"*

*REG. U.S. PAT. OFF.

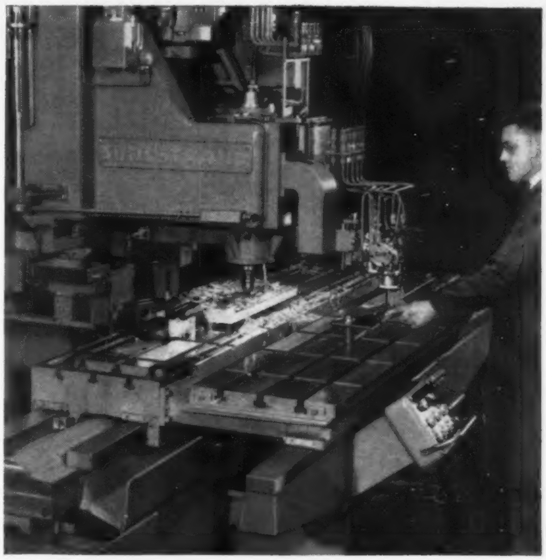


MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

SIMULTANEOUS control of horizontal, vertical, and cross feed is an outstanding feature of the new Sundstrand Tracer Rigidmil. Adequate power for milling from the solid is provided by the 30 hp milling head. You're sure of being able to use the right cutting speed for machining ferrous or nonferrous metals with either HSS or carbide because the Vertical Tracer Rigidmil has both wide speed range and rigid construction.

Vertical spindle head has a low speed range of 52 to 307 rpm at a maximum of 15 hp and a high speed range of 338 to 1990 rpm at 30 hp maximum. Speed range required for a particular machining job is selected with the two-position lever conveniently located on the side of the head. Additional speed changes within the range selected are made by pick-off change gears.

Head is mounted on vertical ways of a cross-traveling column. The vertical travel of the spindle head is 20" and cross-travel is 24" (12" either side of table centerline). Machine and template tables both have a working surface of 18" x 90". Machine table travel is 60". Head carrier cross feed and table longitudinal feed are infinitely variable between 0 and 28 ipm. Both have a rapid traverse rate of 80 ipm.

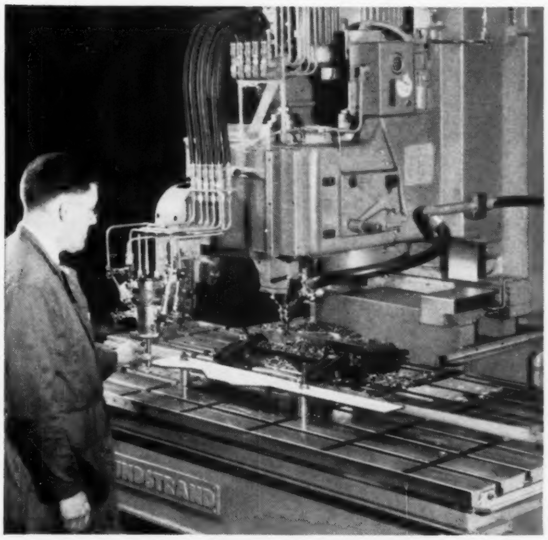


Shown above is the Vertical Tracer Rigidmil performing 360 degree tracing on aluminum parts.

TYPICAL CUTS

Here are only a few of the irregularly shaped cuts that can be made on parts such as bulkheads, wing spars, wing caps, etc. in either ferrous or nonferrous metals.

Sizable cuts are readily handled when machining steel because machine combines high horsepower with rigid construction.

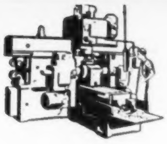


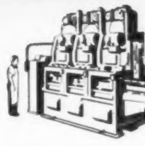
The pencil-type stylus control can be set for either 3-dimensional tracing or for 360-degree tracing in the horizontal plane. When using 360-degree tracing, depth is controlled precisely by means of eight manually selected, adjustable vertical stops. The valve has a quick-change stylus chuck and manual adjustment for limiting maximum feed rate.

More Tracer Milling Facts

. . . using the new Vertical Tracer Rigidmil are contained in Bulletin 681. Write for your copy today.

TRIPLEX RIGIDMILS | **SPECIAL MACHINES**

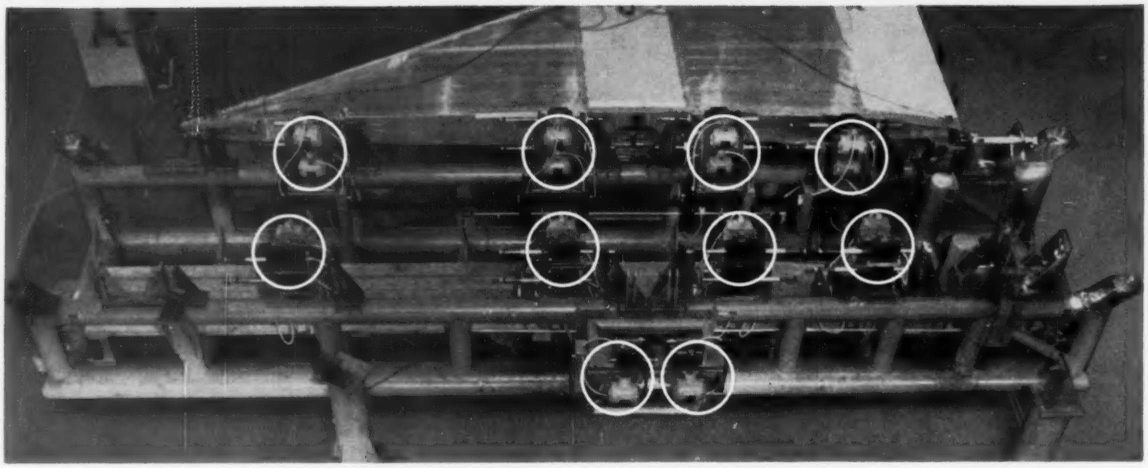




SUNDSTRAND
Machine Tool Co.

2530 Eleventh St. • Rockford, Ill., U.S.A.

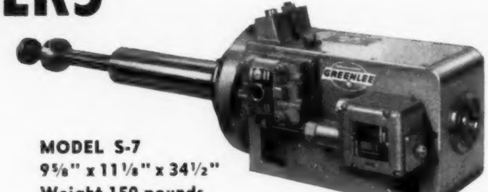
CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**



Precision Boring In Assembly with

GREENLEE HYDRO-BORERS

Build precision boring right into your production setups! Shown in the Convair wing job above, sixteen model S-6 Hydro-Borers and four special Hydro-Borers are mounted directly on the wing jig. They are specifically designed for mounting on jigs and multiple-station machines. Find out how Greenlee Precision Hydro-Borers simplify your production setups . . . save time, space and money . . . and bore to a tolerance of .0003″.



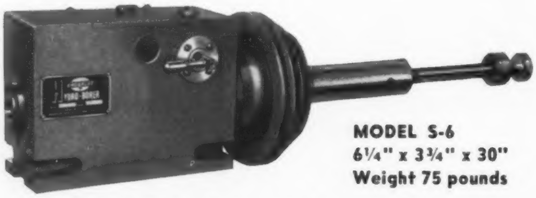
MODEL S-7
9⅝" x 11⅛" x 34½"
Weight 150 pounds

Similar to model S-6 except larger and heavier with greater work capacity. Combines versatility and precision unmatched in its field and range of operations. Patented feed principle enables boring within a a tolerance of .0003″.

WRITE FOR FURTHER INFORMATION

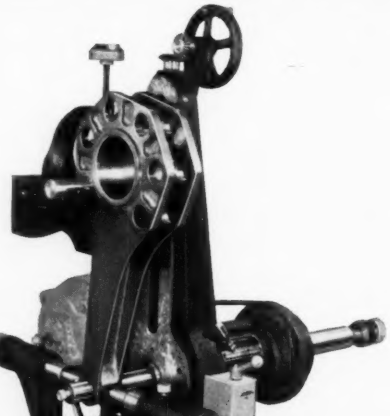
MODEL C-4
11¼" x 9" x 30"
Weight 90 pounds

Model C-4 Hydro-Borer is easily mounted on any type of base. Fixtures mount on face of machine. Adjustable stop in either direction. Optionally furnished with automatic trip and spindle return.



MODEL S-6
6¼" x 3¾" x 30"
Weight 75 pounds

Model S-6 Hydro-Borer can be mounted in various positions on workholding fixtures and assembly jigs. Capable of various feeds in two ranges: .002″ to .004″ and .0035″ to .007″ per revolution.



MODEL A-4 MASTER ROD HYDRO-BORER

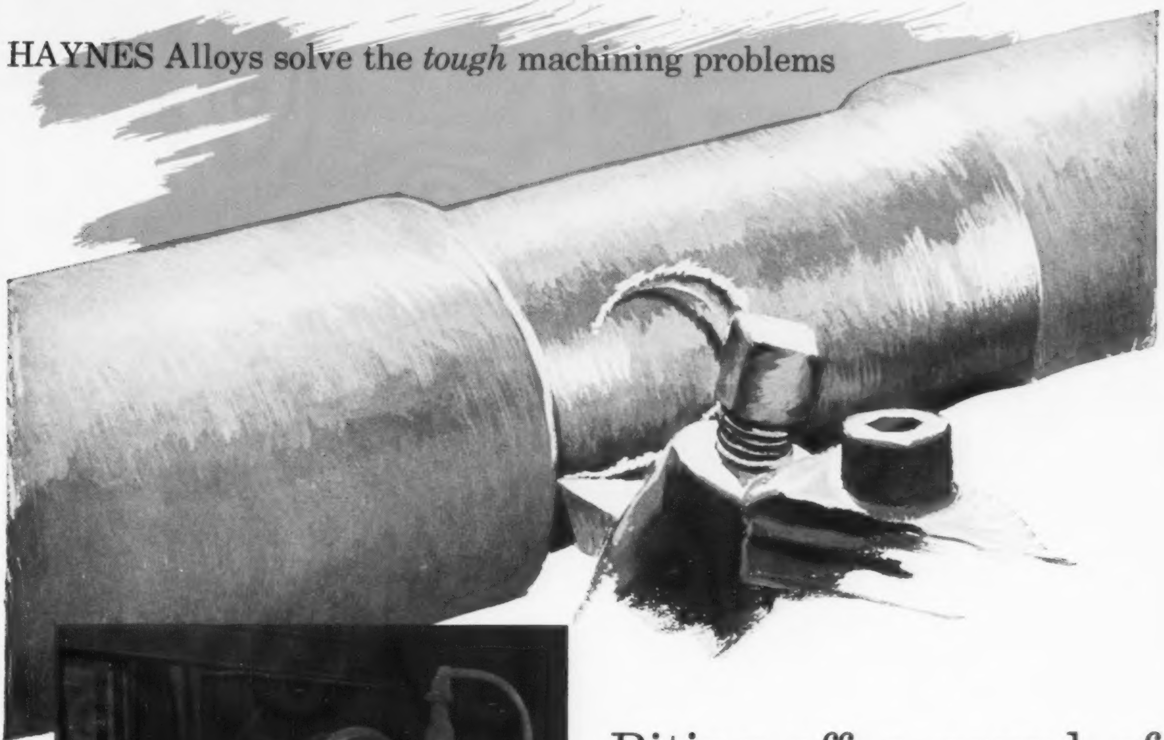
Model A-4 Hydro-Borer for boring crank-pin holes and wrist-pin holes in aircraft engine connecting rods.

PRODUCTION MACHINERY GREENLEE

GREENLEE BROS. & CO.
1867 MASON AVENUE
Rockford, Illinois
Telephone 3-4881

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

HAYNES Alloys solve the *tough* machining problems



Removing metal fast from hard alloys— HAYNES STELLITE alloy tool removes surface imperfections from a hard chromium-nickel ingot. The 98M2 tool is the only one that will handle this machining job successfully.

Biting off a pound of tough alloy per minute

It takes an unusual tool bit to survive the impact of a deep cut when machining rough alloy billets—and still retain a sharp cutting edge while operating at red-heat temperatures.

Yet HAYNES STELLITE alloy tools handle these jobs in stride. At one plant, for example, they have been the standard tool material for the past 10 years machining 6-inch diameter chromium-nickel billets—a particularly rugged operation. A 98M2 tool completely machines $2\frac{1}{2}$-foot long billets, making cuts that range up to $\frac{1}{2}$ in. deep.

For more information, write for our *Metal-Cutting Tool Manual.* Address Haynes Stellite Company, Division of Union Carbide Corporation, General Offices and Works, Kokomo, Indiana.

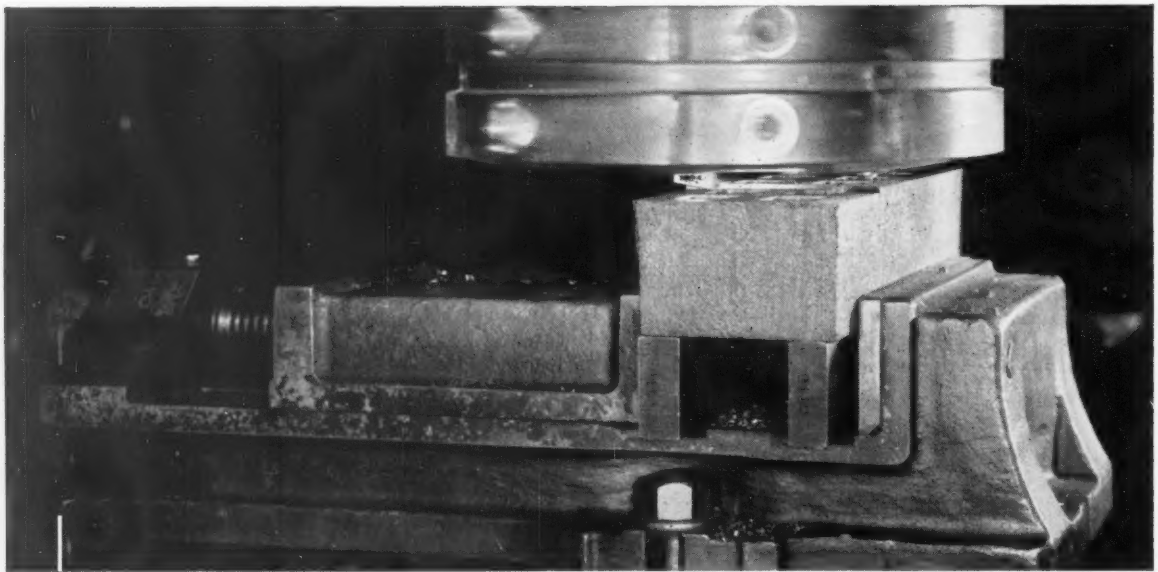
HAYNES
ALLOYS
HAYNES STELLITE COMPANY
Division of Union Carbide Corporation

UNION CARBIDE

For more information fill in page number on Inquiry Card, on page 259

On any material, any job . . .

INCREASE PRODUCTIVITY, CUT UNIT



Output boosted 20%-30% with Grade 860

Milling gray cast iron. Cemented carbide increased production, yet provided longer tool life, better finishes on the new hard, dense types of gray cast iron. Tests on simulated engine blocks (above) showed Grade 860 took interrupted cuts with minute wear, no chipping . . . while other carbides showed extensive chipping and cratering.

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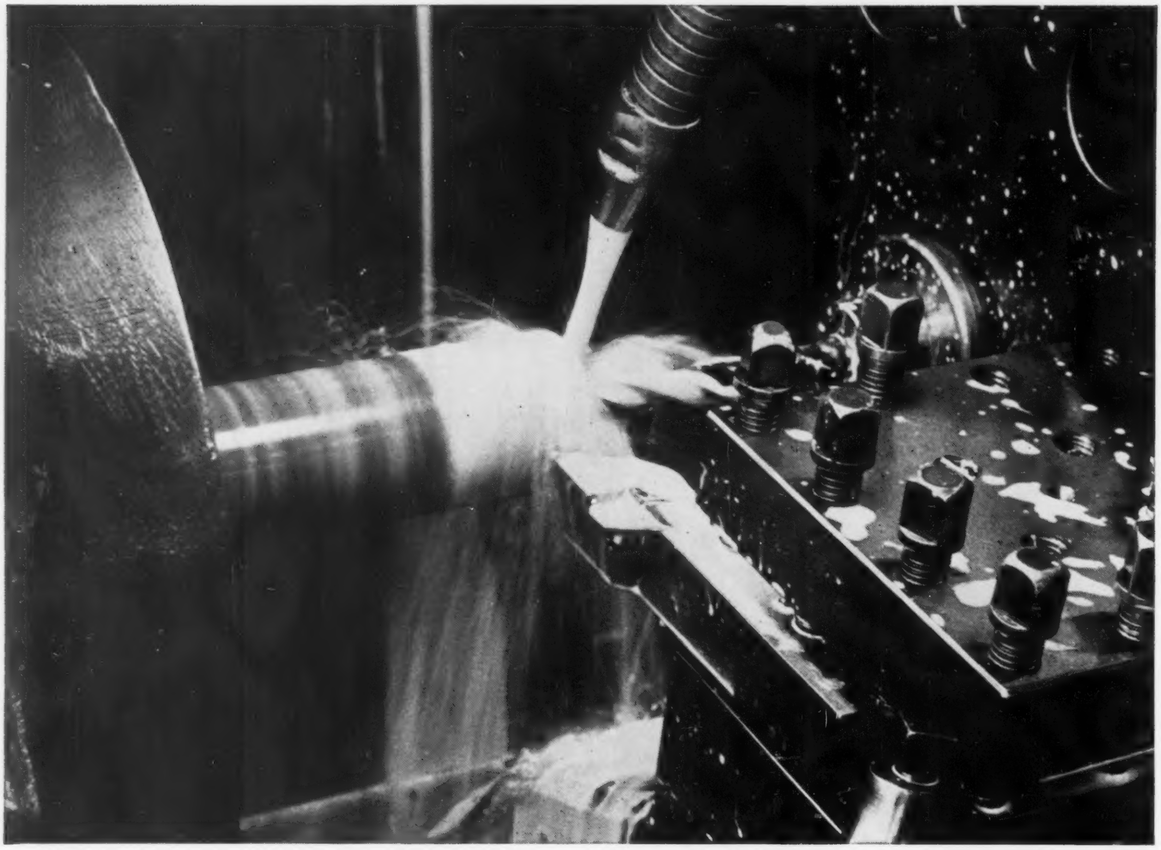


How to get full value from your automatic machine tools...at no extra cost

EVERY time you stop to adjust your automatic machine tools, you reduce their potential. But if the steel you machine is uniform, you reduce these costly interruptions. The more uniform the steel you machine, the more available your machine tools become for increased production.

Timken® fine alloy steel is uniform from bar to bar, heat to heat, order to order. We take *extra* quality control steps to make it that way. For example, we use a magnetic stirrer—the first in the U. S.—to distribute alloys equally in molten steel, keep temperatures constant, work the slag continuously. The industry's first direct-reading spectrometer insures uniform composition right up to the tapping—helps keep grain size uniform, too.

And your order is handled individually. We stamp each bar to identify its heat, even adjust our conditioning procedure to meet your end use requirement.

We're steelmakers because we need the finest quality steel for Timken bearings. The Timken steel you buy must meet these same exacting standards. Always specify Timken fine alloy steel. You'll get time and money-saving uniformity, a more uniform finished product. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, O. Cable: "TIMROSCO".

TIMKEN *Fine Alloy* **STEEL**

TRADE-MARK REG. U. S. PAT. OFF.

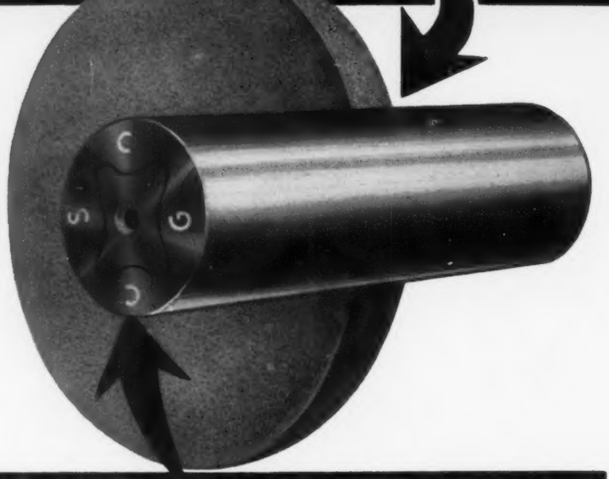
SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

An exclusive GRINDING PROCESS...

makes

CUMBERLAND
STEEL BARS

concentric, straight,
smooth & *really* accurate



BE SURE OF THIS MARK ON THE END OF YOUR SHAFTS

CUMBERLAND GROUND BARS FOR ALL TYPES OF MACHINES

They are carefully ground to our standard manufacturing tolerance, plus nothing to minus .002″ on diameters 1-1/8″ to 2-7/16″ inclusive . . . plus nothing to minus .003″ on diameters 2-1/2″ to 8″ inclusive. Closer tolerance can be furnished, if desired. And, remember, Cumberland Steel Bars are the end result of 109 years' experience,—and every bar is *carefully tested* before shipment. The list of Cumberland's customers reads like the "Blue Book" of Industry. Ask for further information.

MANUFACTURED IN THREE SPECIFICATIONS

Cumberland Brand—AISI C-1020/C-1025, Elastic Limit 30,000# Min.
Potomac Brand—AISI C-1040, Elastic Limit 45,000# Min.
Cumsco Brand—AISI C-1141, Elastic Limit 57,000# Min.

CUMBERLAND STEEL COMPANY

CUMBERLAND, MARYLAND, U.S.A.

ESTABLISHED 1845 INCORPORATED 1892

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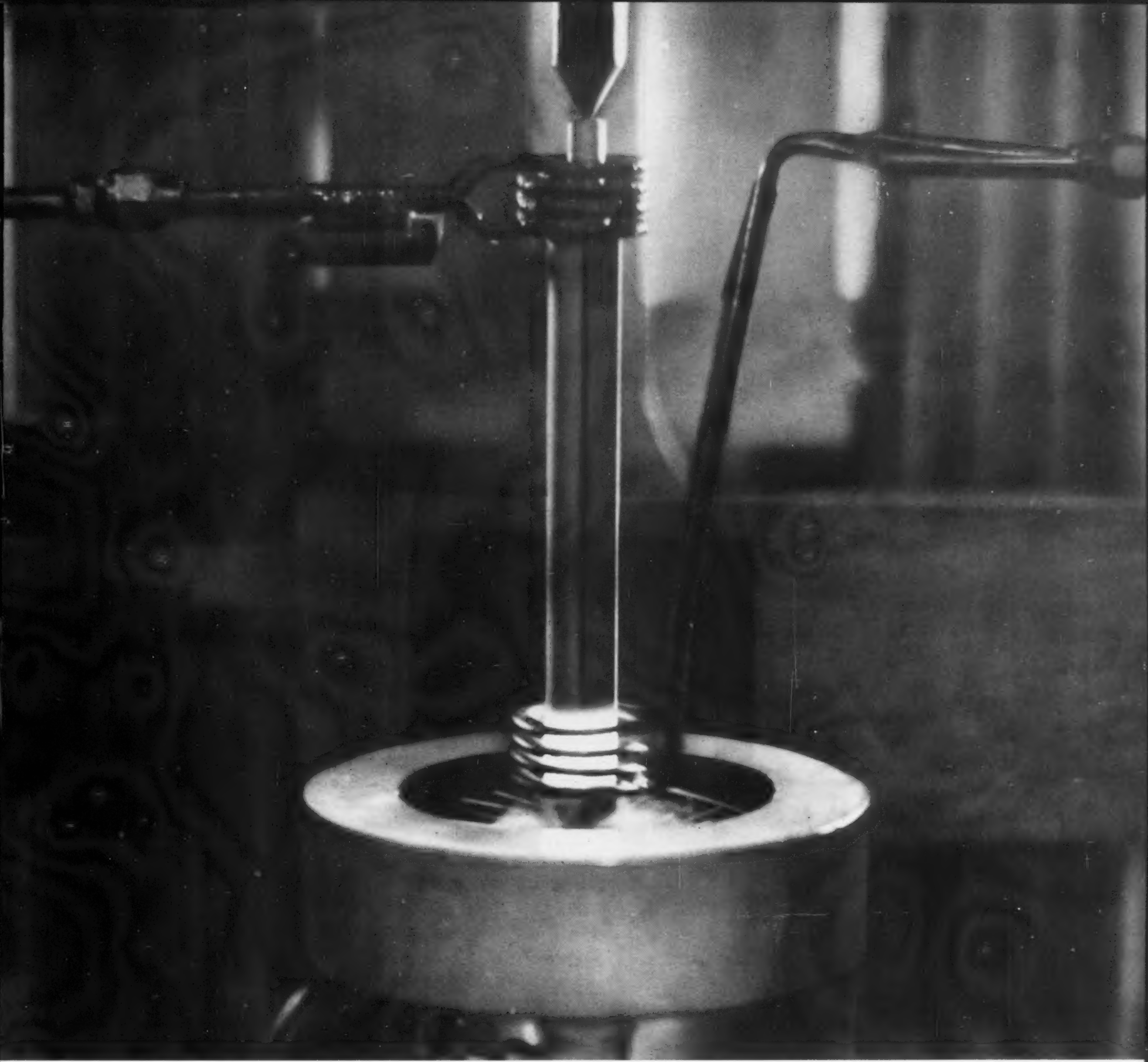

DO YOU NEED BETTER METAL CLEANERS FOR THESE JOBS?

Will you take a few seconds to check this list and circle in the coupon the numbers of the jobs on which you need better results?

1	**Cleaning aluminum in preparation for anodizing.** See pages 4 to 8 in "How to clean metals in aircraft production."
2	**Cleaning and deoxidizing aluminum in preparation for spot welding.** See pages 10 to 14.
3	**Cleaning and conditioning aluminum in preparation for painting.** See pages 15 to 19.
4	**Cleaning aluminum after heat treating.** See page 20.
5	**Stripping paint from aluminum.** See pages 22 to 26.
6	**Cleaning magnesium.** See pages 27 to 29.
7	**Controlling overspray in paint booths.** See pages 36 to 37.
8	**Cleaning engine test cells.** See page 40.

FREE Write for your copy of this 48-page illustrated booklet.

Oakite Products, Inc., 26 Rector St., New York 6, N. Y.

Send me a FREE copy of your booklet *"How to clean metals in aircraft production."*

I am interested in getting better results in the cleaning jobs indicated by the numbers I have circled below:

1 2 3 4 5 6 7 8

NAME

COMPANY

ADDRESS

Technical Service Representatives in Principal Cities of U. S. and Canada

Export Division
Cable Address: Oakite

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS · METHODS · SERVICE
SCIENCE

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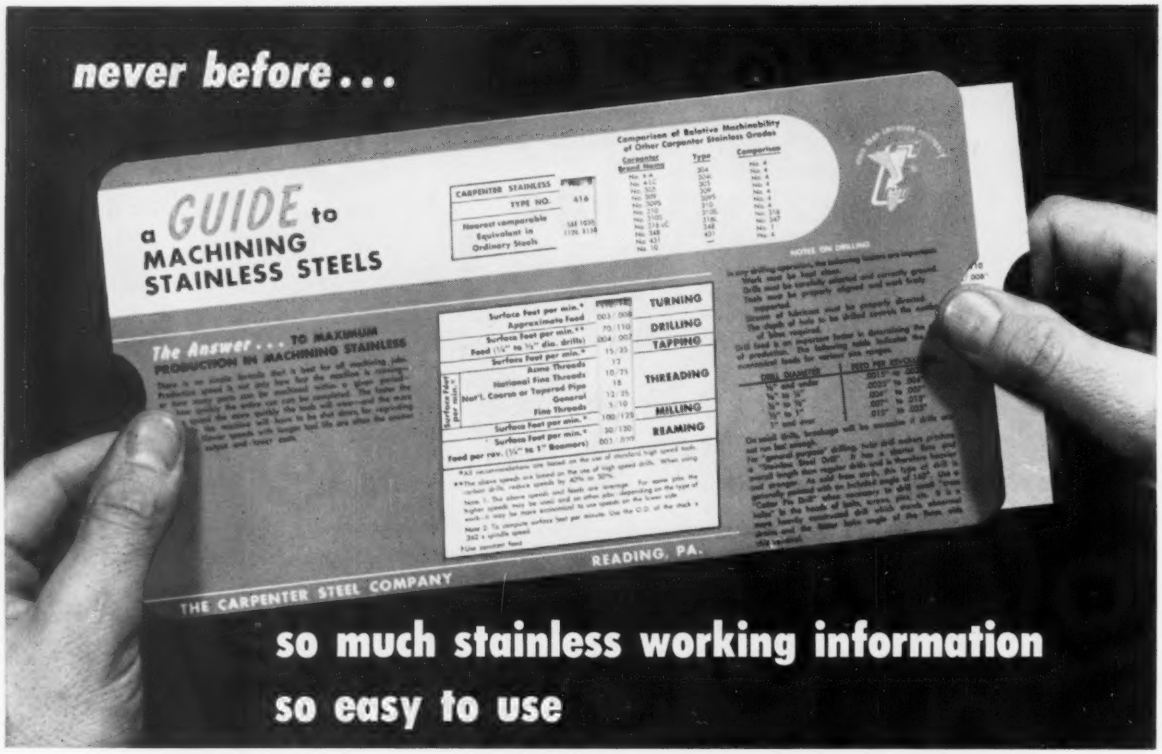

Carpenter's new stainless slide chart is a guide

Here's the newest example—*just off the press*—of how Carpenter printed information is designed to help you and your men when working with stainless.

Now, right at your fingertips, you can have practical data to help you make the most of every pound of stainless you use . . . quickly answer many time-consuming daily questions.

For the first time, with slide chart ease, accuracy and convenience, you can quickly uncover working information about machining speeds and feeds, for *turning, drilling, tapping, threading, milling and reaming*. One entire side is devoted to such helpful facts as these—all taken from Carpenter's widely used "Notebook on Machining Stainless Steels".

The reverse side is equally valuable. Completely up-to-date, it gives the relative workability for many stainless grades . . . helps you quickly pinpoint the proper stainless for drawing, forging, heading, swaging, welding, buffing, etc.

For your personal copy, simply drop us a line on your company letterhead. If you'd like some extra copies of this NEW Carpenter Stainless Slide Chart for others in your plant, just tell us.

These formulas are just a sample of the help you can expect from Carpenter's NEW Stainless Slide Chart.

No. 1 — for obtaining tap drill size:

$$\left.\begin{array}{c}\text{Outside}\\\text{Diameter}\end{array}\right\} - \frac{.0130 \times \%\ \text{Full Thread}}{\text{Number of threads per inch}} = \text{Drill Size}$$

Example - for ¼" × 20 thread:

$$.250 - \frac{.0130'' \times 75}{20} = .2013 \text{ or number 7 drill}$$

No. 2 — for obtaining percentage of thread a given drill will produce:

$$\frac{(\text{Outside dia.} - \text{drill size}) \times \text{number threads per inch}}{.0130} = \%\ \text{of full thread}$$

Example - for ¼" × 20 thread:

$$\frac{(.250 - .201) \times 20}{.0130} = 75.4\%\ \text{thread}$$

Carpenter STEEL

Free-Machining Stainless Steels

The Carpenter Steel Company, 105 W. Bern St., Reading, Pa.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"

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Tool Steel Topics

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

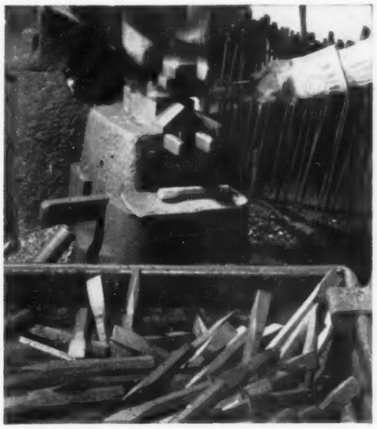
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM TOOL STEEL ENGINEER SAYS:

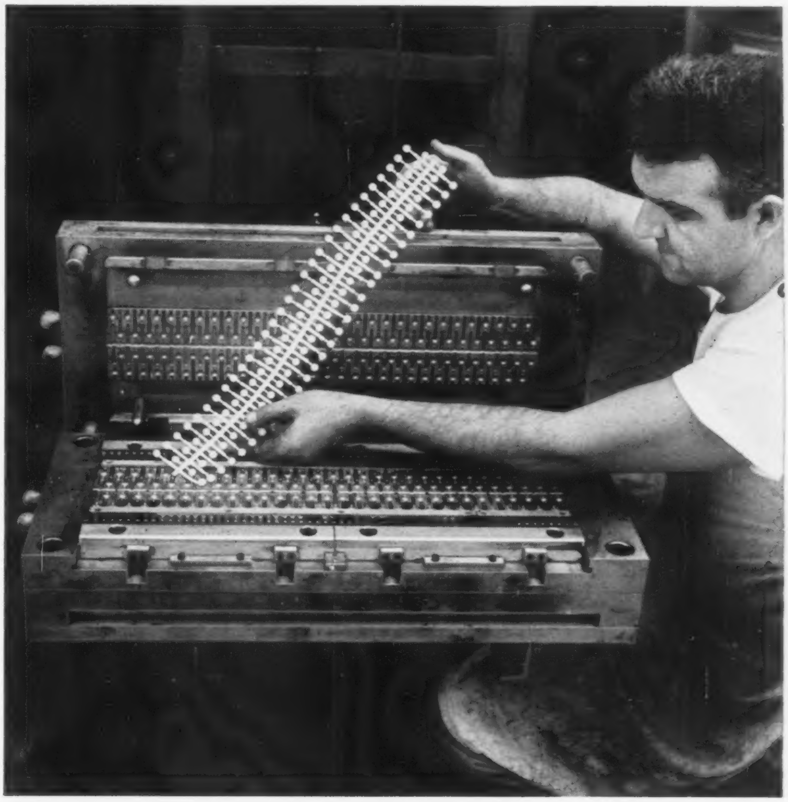
Air-Quenching Adds to Life of Hot-work Tools

Most hot-work tool steels can be hardened by quenching in oil or air. Because of convenience in handling, and in order to avoid excessive scaling, many hot-work tools are oil-quenched. However, air-quenching is better practice because air-quenched tools have lower residual stresses than tools which have been liquid quenched. Since heat-check failures develop from surface stresses produced in service, the presence of residual stresses in the tool itself can lead to premature failure. Tools with low residual stresses are best suited for long service life on hot-work applications. That's why air-quenching is usually considered the most practical procedure for hot-work tools.



Putting the Bite in Chisel Steel

At Stanley Tool's Atha Plant, Newark, N. J., dies of Bethlehem Lehigh H tool steel are used in trip hammers of this type to forge cold chisel blades. Lehigh H, our special-purpose high-carbon, high-chromium grade, is ideal for this type of application because of its excellent wear-resistance and adequate red hardness.



INJECTION MOLD OF DURAMOLD B

Pops Out Plastic Poppit Beads

This injection mold, containing 120 cavities, is used in an 8-oz injection machine to produce one size of the popular polyethylene Poppit Beads. The mold is made of Bethlehem Duramold B tool steel, and was produced by R. A. Koegl Stamp & Die Works, Hillside, N. J., from steel supplied by Ackerlind Steel Co., Inc., New York.

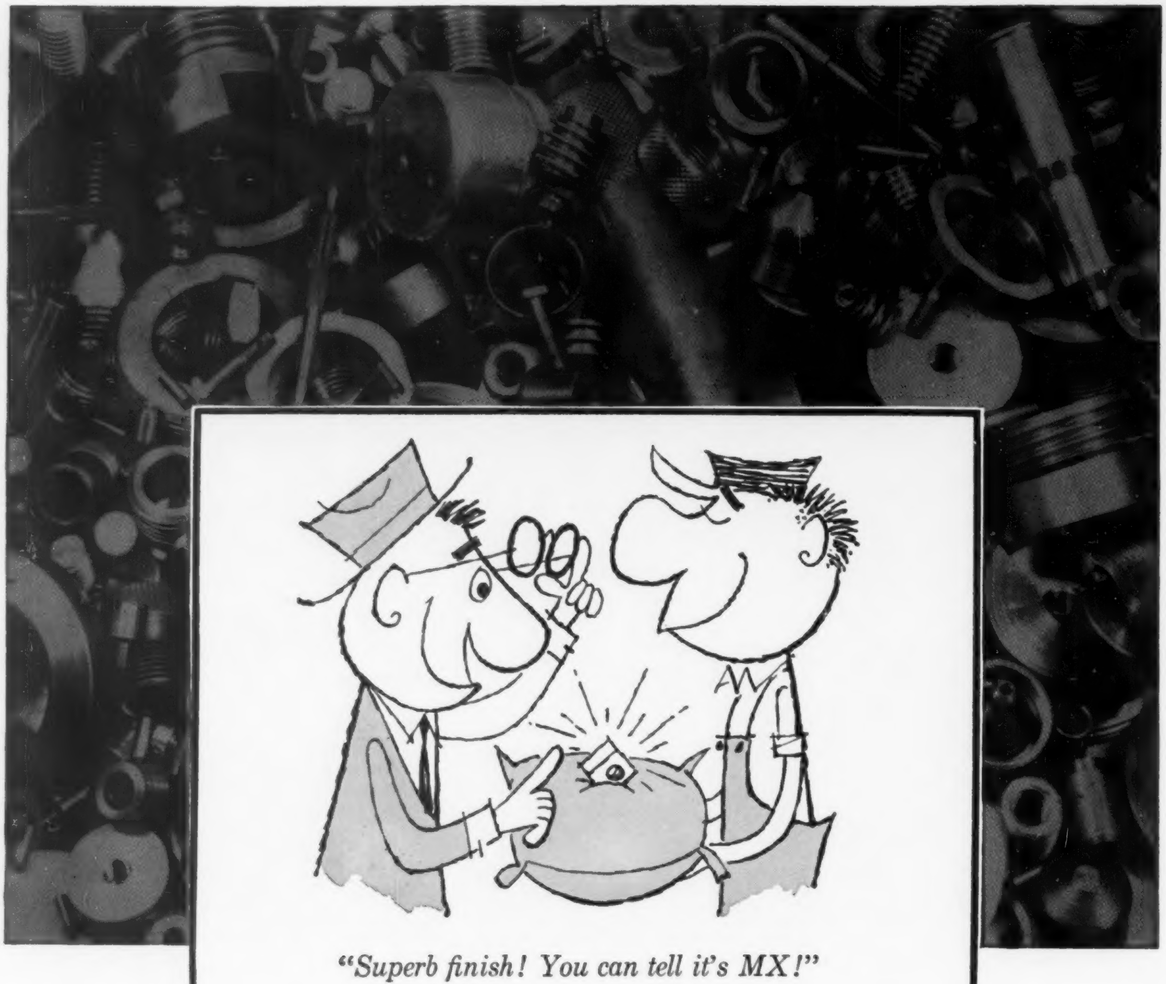
Duramold B is an oil-hardening, chromium-type of plastic-molding die steel, with an addition of boron. In heat-treatment, it develops a surface hardness of Rockwell C62.

Duramold B is ideal for long service life because of its high core-strength and resistance to wear. Toolmakers are sure to like it because it can be annealed to a hardness of 100 max Brinell, which permits easy cold hobbing, even where deep or large cavities are used.

Typical Analysis

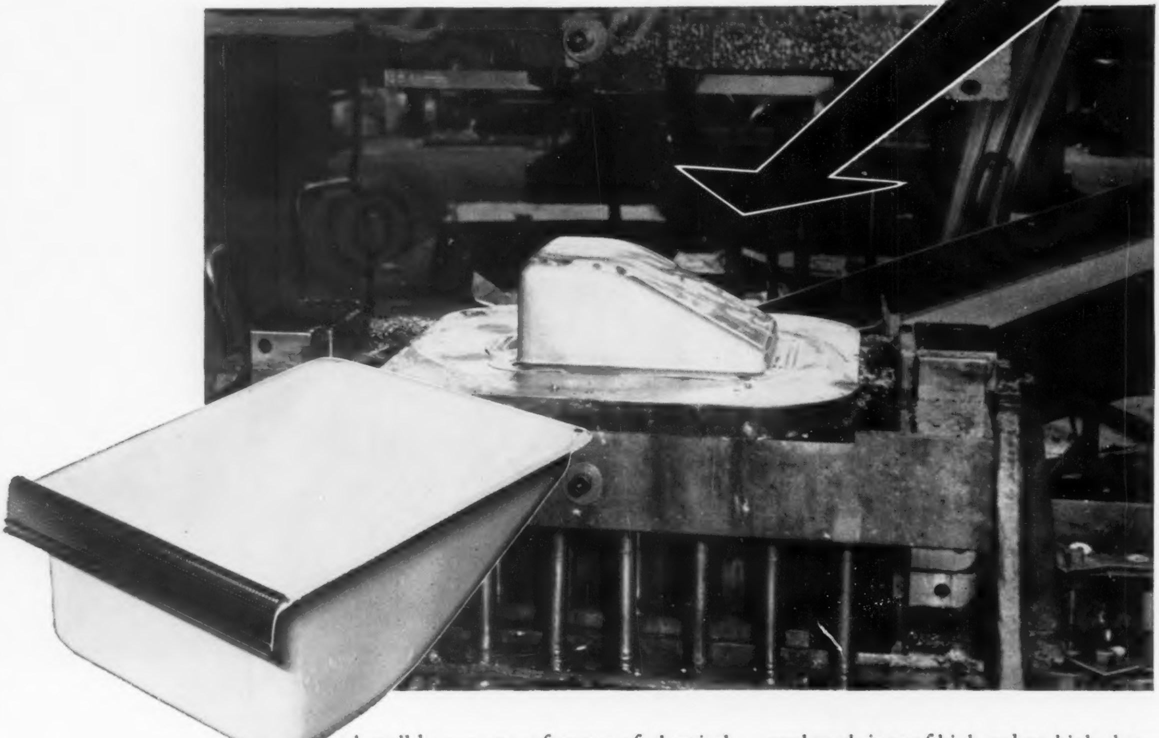
Carbon 0.07	Manganese 0.30
Silicon 0.15	Chromium 1.00
Molybdenum 0.25	Boron added

To order a trial piece of Duramold B, or obtain detailed information about this or any other grade in Bethlehem's complete family of tool steels, simply get in touch with your Bethlehem tool steel distributor.



"Superb finish! You can tell it's MX!"

Here's how A-L CAST-TO-SHAPE TOOL STEELS solved a serious scrap problem on this job



A well-known manufacturer of electrical appliances formerly used dies of alloyed ductile iron castings to draw refrigerator crisper pans.

These dies had to be redressed after every 10,000 pieces (approximate cost: $1300 each) and had to be replaced after every 30,000 pieces. 8 to 10% of the pans were scrapped due to defects.

Because of this scrap problem and the severity of the draw—a 52% reduction of the steel—it was decided to rebuild the dies using a suitable grade of tool steel.

A 2″ cut was taken off the top of the old cavity and the draw ring. These cuts were replaced with A-L Cast-to-Shape tool steel rings of high carbon-high chromium analysis. Total cost was nominal compared with buying entirely new dies.

Each of the revised dies has produced approximately 500,000 pans. Their condition indicates that probably *twice* that many can be drawn before the dies must be redressed. Defective pieces have been reduced to a mere 1½ to 2%—*an 80% reduction!*

● Ask your A-L representative TODAY how Cast-to-Shape tool steel can help solve your production problems . . . or write *Allegheny Ludlum Steel Corporation, Forging and Casting Division, Detroit 20, Mich.*

SEND FOR THIS NEW CATALOG

"FORGING AND CASTING PRODUCTS"

Contains the latest information on FCC Air Hardening, Oil Hardening and other Cast-to-Shape Tool Steel Specialties that can save you time and money . . . also Composite Die Sections and Smooth Hammered Forgings in a wide range of tool and stainless steels. *Get your copy NOW*

ADDRESS DEPT. M-91

For complete MODERN Tooling, call

Allegheny Ludlum

A-L® FINE TOOL STEELS SINCE 1854

WSW 6123

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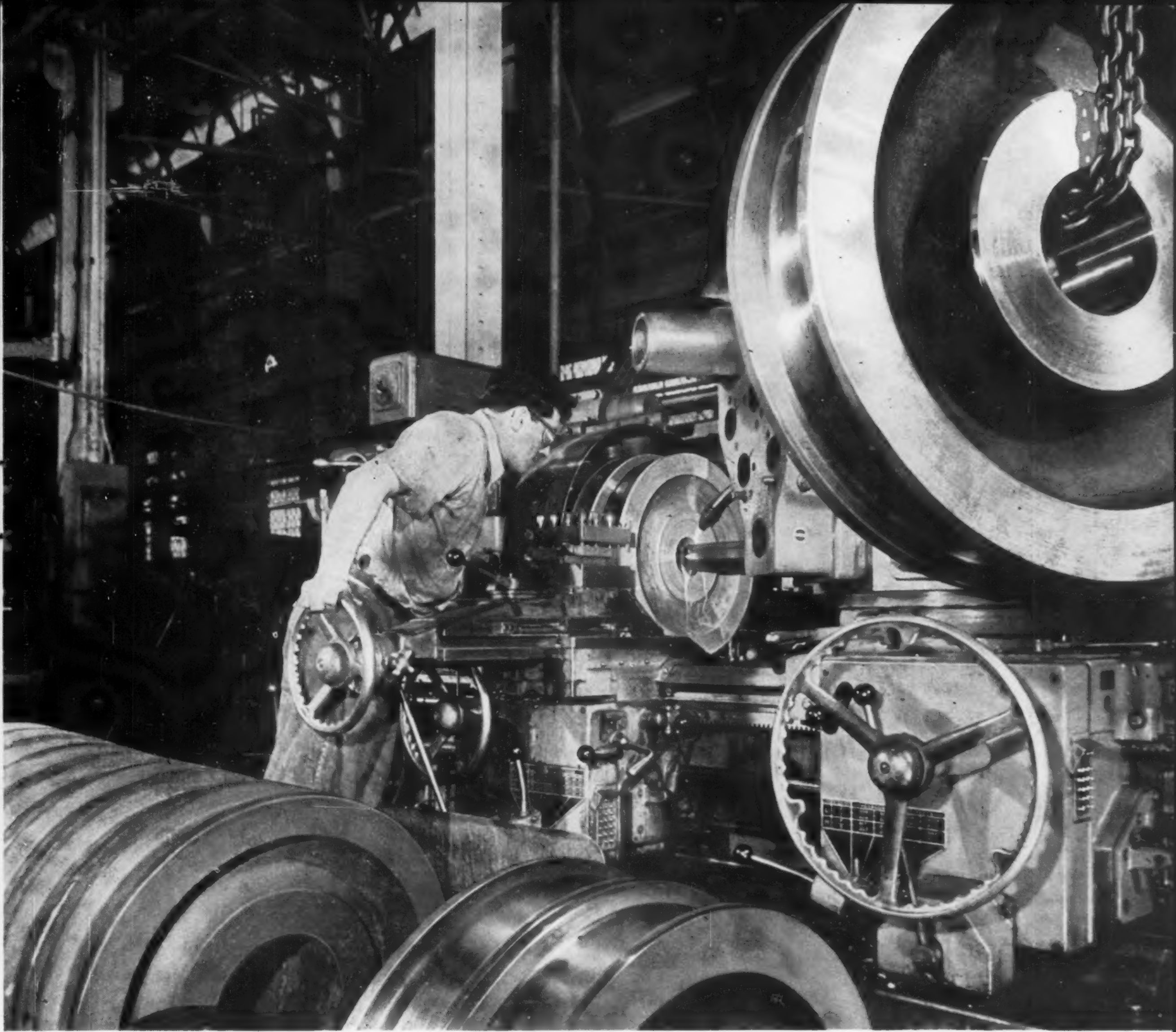

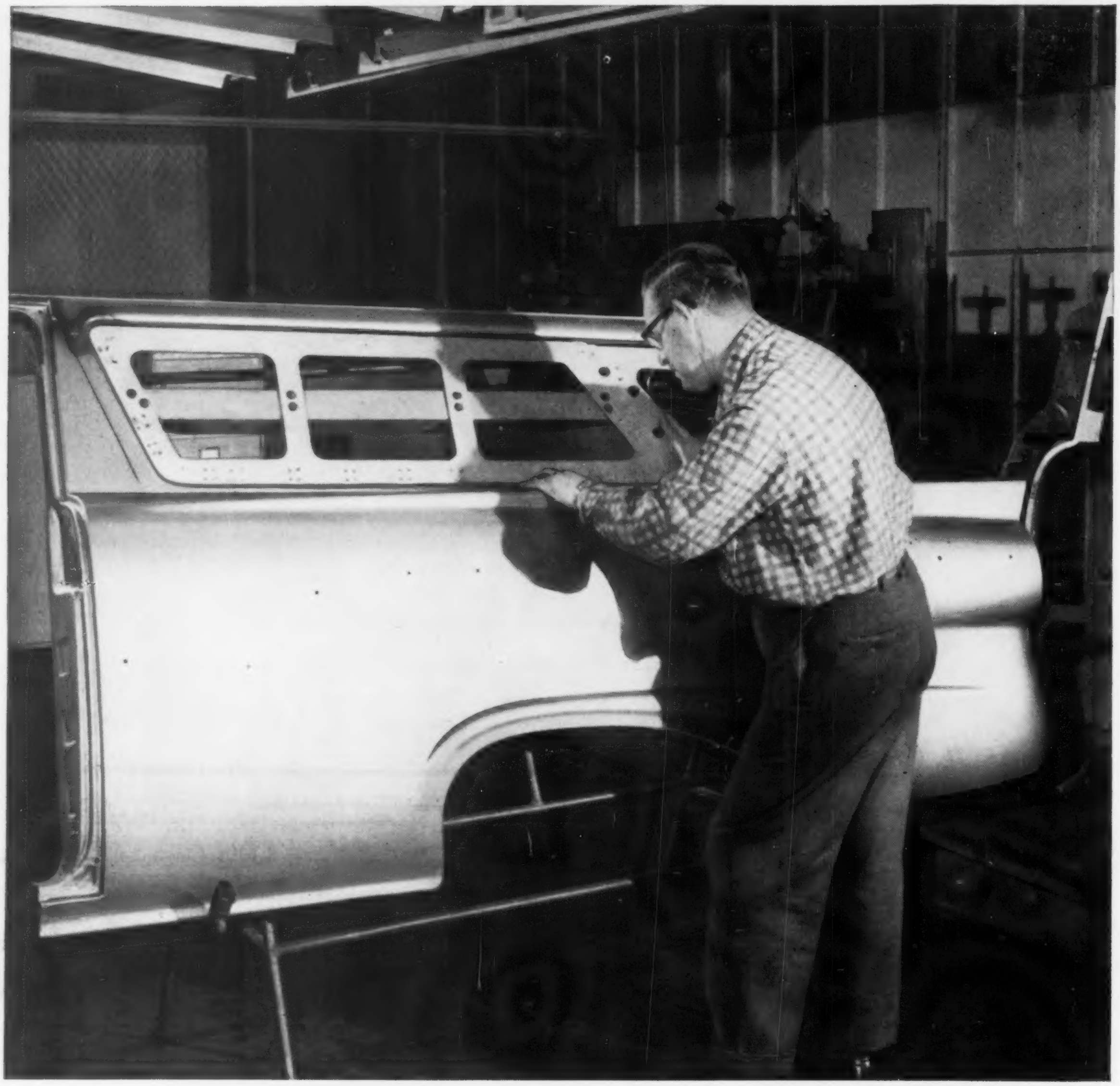

Lightweight magnesium fixture checks Ford station wagons

This magnesium checking fixture is used by Ford Motor Company in assembling Ford two-door station wagons.

It helps to maintain quality by checking the daylight opening relationship to the glass run channel and regulator retainer brackets in the quarter panel welded assembly. It assures accurate location of the glass run retainers and window regulator mounting holes. The fixture is dimensionally stable and has stood up well under continuous rough handling. One man can easily lift and manipulate it with one hand.

Jigs and fixtures made with magnesium are always easy to handle because they weigh much less than steel or aluminum. Magnesium tooling plate is uniformly flat, low in cost and easy to machine, fabricate and weld.

For the full story on magnesium tooling plate contact your nearest supplier of Dow magnesium or write to us.

THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1416Y-1.

AVAILABLE FROM STOCK AT: Copper and Brass Sales, Inc., Detroit, Michigan • Fullerton Steel and Wire Co., Chicago, Ill. Hubbell Metals Inc., St. Louis, Mo. • A. R. Purdy Co., Inc., Lyndhurst, N. J. • Reliance Magnesium Co., Los Angeles, Calif. Vinson Steel and Aluminum Co., Dallas, Texas.

YOU CAN DEPEND ON DOW

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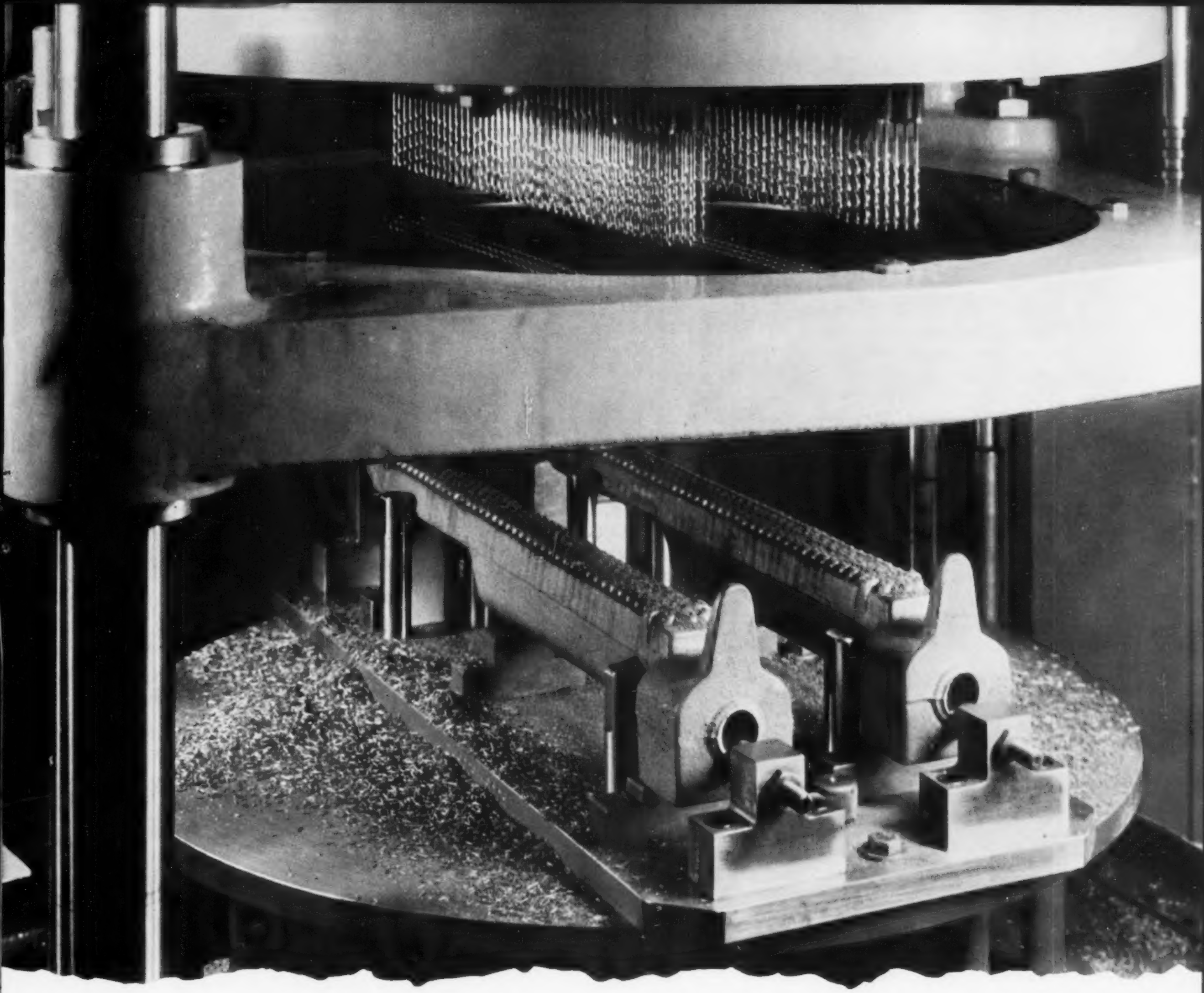


Sharp Clean Cuts EVERY TIME

Many thicknesses and sizes of metal are cut on this Steelweld Shear every day. Thanks to Steelweld's exclusive MICRO-SET knife adjustment, it is easy to set the knife clearance to the exact amount which will produce the best cut for every plate run through the machine.

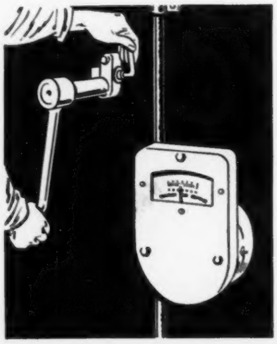
If desired, the knife clearance can be set for an average thickness and all plates cut without changing the clearance. This procedure is used with most shears because to change knife clearance on them is a tedious, difficult operation which usually puts a machine out of service for hours.

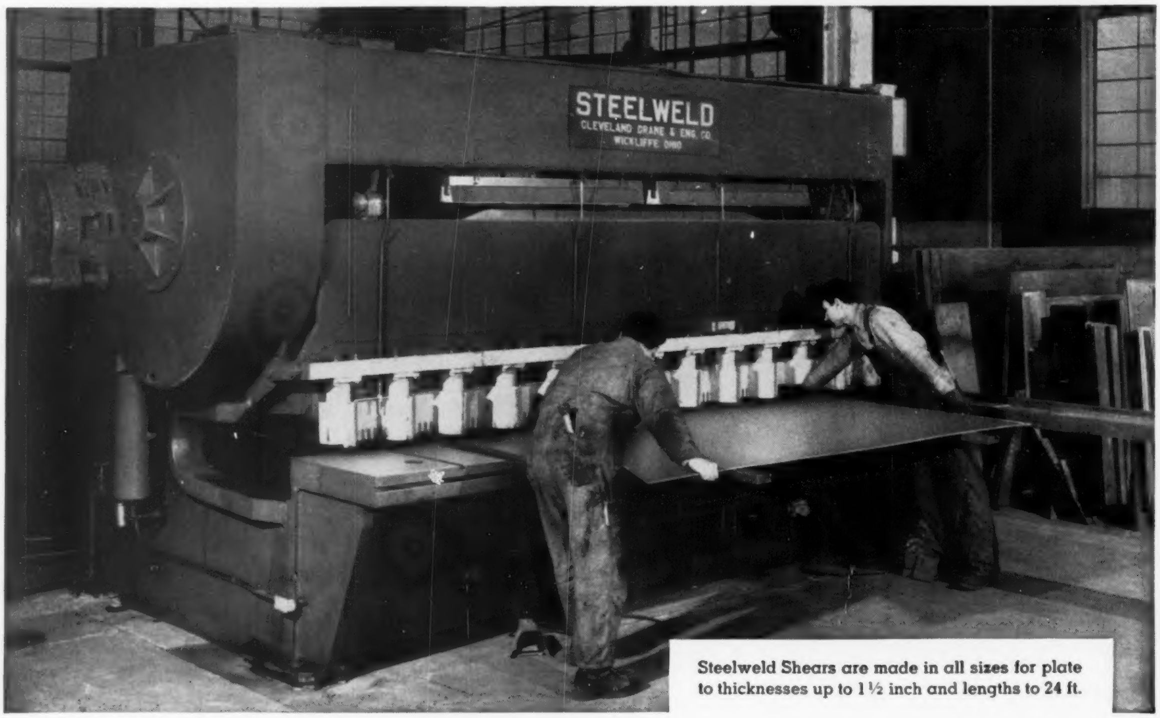
In contrast, knife adjustment on Steelwelds is made in a few seconds. It's simply a matter of turning a crank until an indicator points to the figure representing the thickness of plate being cut. No bolts to loosen; no parts to move. There is no need for using "average" knife settings.

The clutch and brake unit is another outstanding feature of Steelweld Shears. As it is air-operated, it is quick, snappy in action. Its low-inertia design assures cool operation, even after long continuous production runs, because energy to be dissipated is minimized and working pressure necessary on clutch and brake facings is greatly reduced.

The many features of Steelweld Shears make it worth your while to get all the facts.

Because of MICRO-SET Knife Adjustment





Steelweld Shears are made in all sizes for plate to thicknesses up to 1½ inch and lengths to 24 ft.

GET THIS BOOK!

CATALOG No. 2011 gives construction and engineering details. Profusely illustrated.

THE CLEVELAND CRANE & ENGINEERING CO.

5446 EAST 282 STREET, WICKLIFFE, OHIO

STEELWELD PIVOTED BLADE SHEARS

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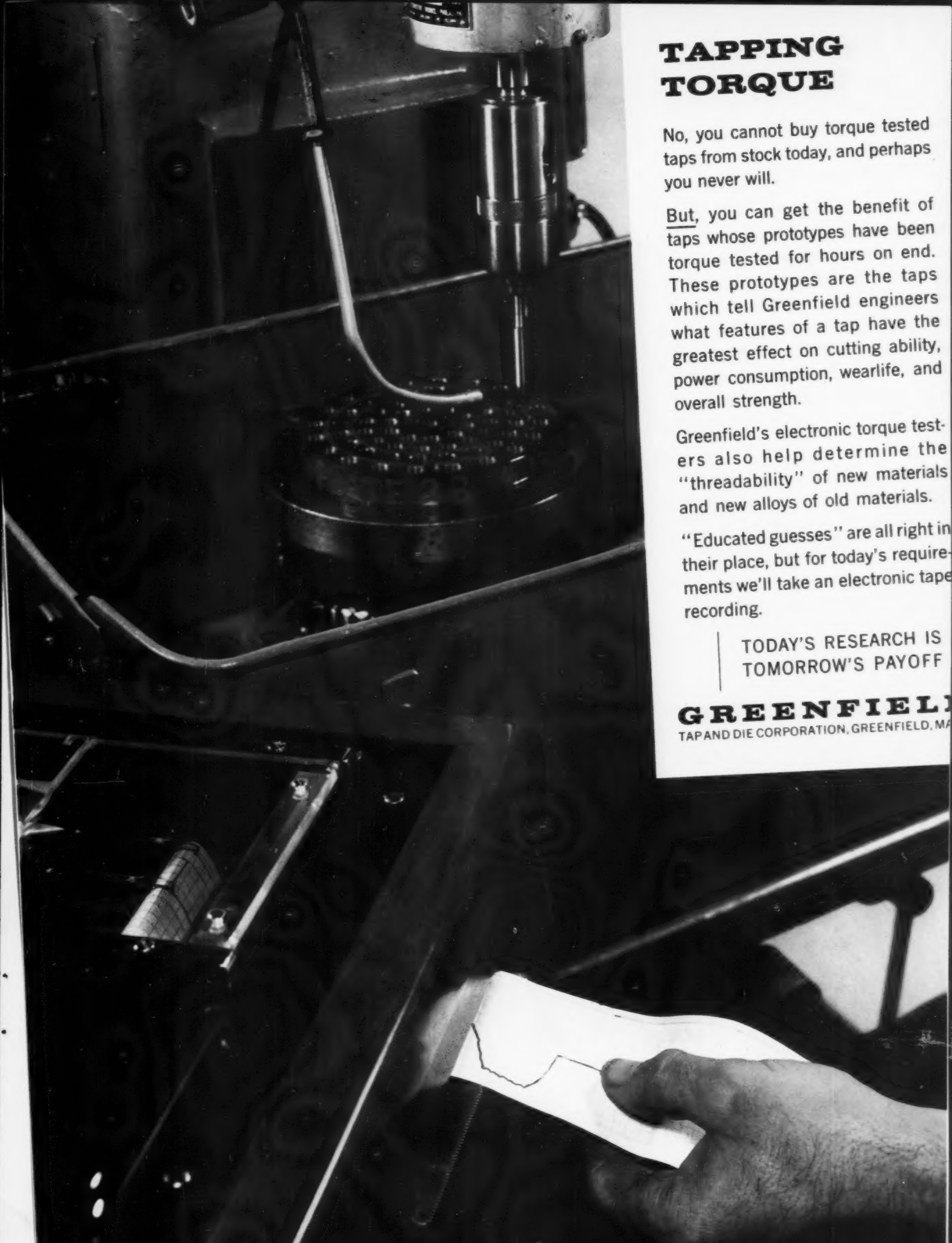
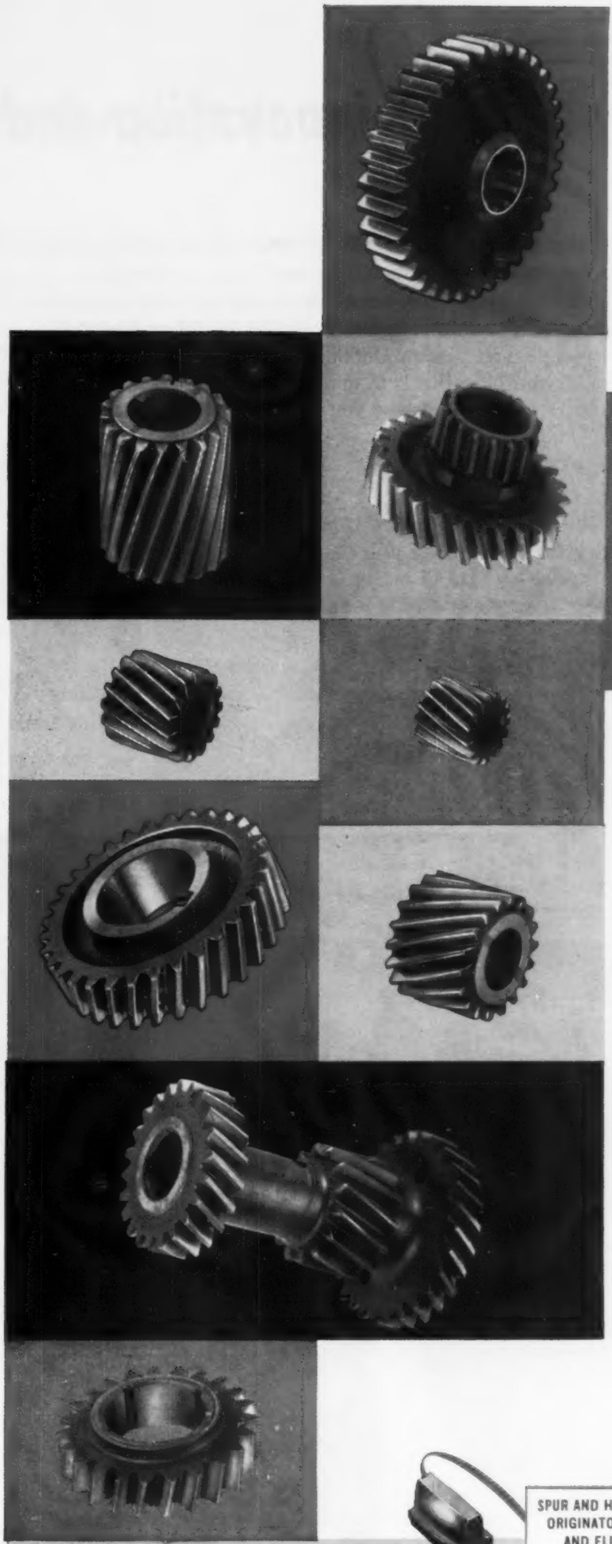

TAPPING TORQUE
No, you cannot buy torque tested taps from stock today, and perhaps you never will.
But, you can get the benefit of taps whose prototypes have been torque tested for hours on end. These prototypes are the taps which tell Greenfield engineers what features of a tap have the greatest effect on cutting ability, power consumption, wearlife, and overall strength.
Greenfield's electronic torque testers also help determine the "threadability" of new materials and new alloys of old materials.
"Educated guesses" are all right in their place, but for today's requirements we'll take an electronic tape recording.
TODAY'S RESEARCH IS TOMORROW'S PAYOFF
GREENFIEL
TAP AND DIE CORPORATION, GREENFIELD, MA
BUY FROM YOUR GREENFIELD DISTRIBUTOR FOR SERVICE AND QU



GEAR TOOTH NICKS and "HICKIES"

HONING IS THE LOW-COST WAY OF SILENCING THEM

You can hone the average automotive transmission gear in from 15 to 60 seconds. This single operation gets rid of all the noisy nicks and hickies that are so troublesome and tedious to deal with in any other way.

But that's not all. Red Ring honing also improves over-all surface finish—down to 2-4 microinches if necessary.

The initial pass under the honing tool is an effective inspection procedure in that it immediately reveals any distortions that may exist in tooth profile, spacing and pitch diameter runout. When such distortions are not excessive, honing corrects them.

If you want to reduce the cost of silencing noisy gears (1″ to 12″ PD), write for Bulletin H 57-2.

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING
AND ELLIPTOID TOOTH FORM

7810

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

OVER TWENTY YEARS OF

Onsrud® innovation and

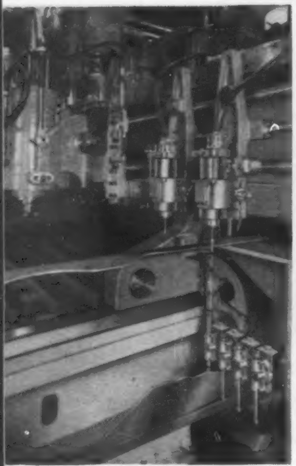
SPECIALLY DESIGNED FOR HIGH-SPEED ALUMINUM MILLING

● Everything Onsrud designs and builds . . . from machine tool components supplied to equipment builders to complete milling machines . . . everything from a 20 ounce high speed spindle to a 100 ton electronically controlled contour mill . . . is made for the specific purpose of milling ALUMINUM and related nonferrous metals. As you plan for new production or review your present methods and machines, if your objective is to find the means of *reducing costs,* be sure to let an Onsrud representative show you the ways Onsrud specialization can help you.

PROVED BY EXPERIENCE

● Onsrud has been a designer and supplier of production milling machines for the aircraft industry for over twenty years. Since 1945 Onsrud has developed a series of special high speed machines now in use in a variety of industries . . . all for the mass production milling of aluminum and other nonferrous metal parts.

Onsrud today has successfully developed and built special electronically controlled milling machines for hyper-speed face, profile and contour milling involving three dimensional and three directional infinitely variable milling feeds.



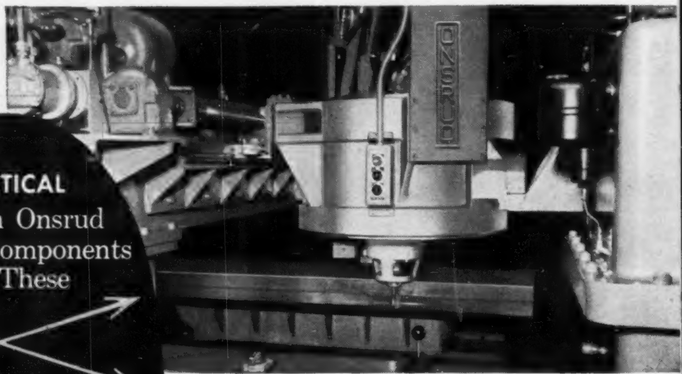
ELECTRONIC CONTROL SYSTEMS For control of speeds and feeds beyond the limits of mechanical systems and manual control . . . and extension of production milling machine application to parts impossible to machine before. Designed and built as Selsyn follower, analog and digital systems.

HIGH SPEED INDUCTION MOTORS Built in capacities from 1 to 150 HP, for spindle speeds from 3,600 to 20,000 RPM. Air or liquid cooled for greatest possible sustained and intermittent overloads.

PRACTICAL

Through Onsrud Machine Components Like These

A wide variety of components are offered to manufacturers wishing to build their own special machines . . . components that are also employed in Onsrud designed and built milling machines. Typical components include:



INVOMIL® ROTARY MILLING HEAD

One of the most unusual milling head assemblies in the machine tool field. Provides infinite rotary feed of milling head through 360°. When mounted on gantry type carriage, in combination with conventional transverse and longitudinal feeds, provides infinite feed of milling head through any point on table.

HYPER-SPEED SPINDLES

Specially designed and built for the high rotational speeds of Onsrud motors. Assemblies equipped with preloaded bearings for precision end milling application. Dynamically balanced for vibration-free operation.

FAMOUS ONSRUD FIRSTS

- air turbine drives
- Metered Mist lubrication systems for high speed spindles
- water and air cooled high cycle induction drive motors
- InvOmil rotary feed milling head
- rotary table feed for automatic milling

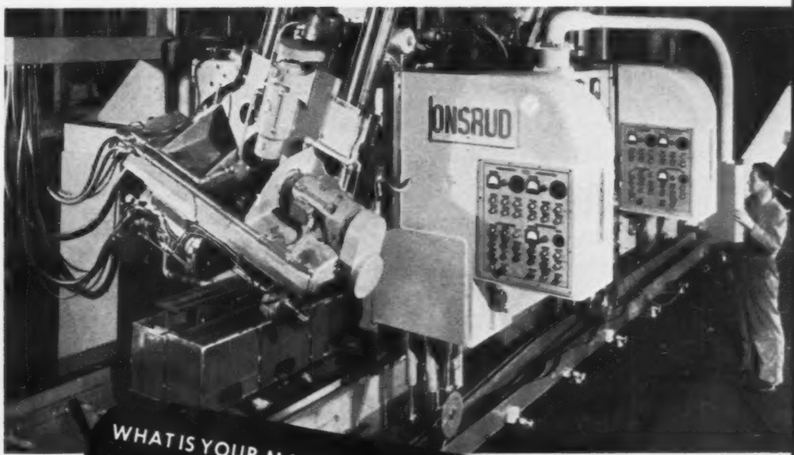
Onsrud® ——— FOR

leadership to serve you...

When the parts to be milled are
ALUMINUM
Alloys or related nonferrous metals

TYPICAL ONSRUD MACHINES NOW USED IN PRODUCTION MILLING

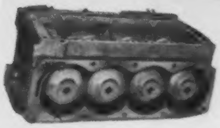
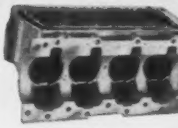
Onsrud A90-36 Automatic Contour or Profile Milling Machine with electronic and electro-hydraulic tracer Selsyn control system. For milling aircraft spar beams and other structural members. Reduces machine time and expands application. A precision machine for high speed automatic production.



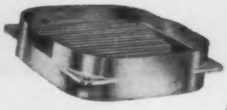
Onsrud A-242S Tri-Way Milling Machine. One vertical and two horizontal milling heads operate at one time to mill three sides of part.

Onsrud AA50-AE Rotary Feed Milling Machine, equipped with vertical head mounted on pivoted overarm. Follower on head assembly follows template as milling cutter reproduces template contour or line on work piece.

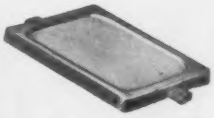
WHAT IS YOUR MACHINING TIME NOW ON PARTS LIKE THESE?
These parts are a few examples of the production time savings possible with Onsrud equipment.

Outboard Motor Housing, aluminum alloy casting, 7" wide x 13" long and 6" high. Machine three faces in one setup. Production... three complete parts per minute.



Double Section Skillet, aluminum alloy casting, 10½" square x 3" high. Three different setups to complete parts. Production per setup... three parts per minute.



Flat Griddle, aluminum alloy casting, 11" x 11⅛" x 9/16" high. Machine four sides and face of top rim in one setup. Production . . .two parts per minute.

Aluminum alloy carburetor part. Face mill two sides . . . production four parts per minute.

Steam iron sole plate, aluminum alloy. Face milling operation . . . six parts per minute.

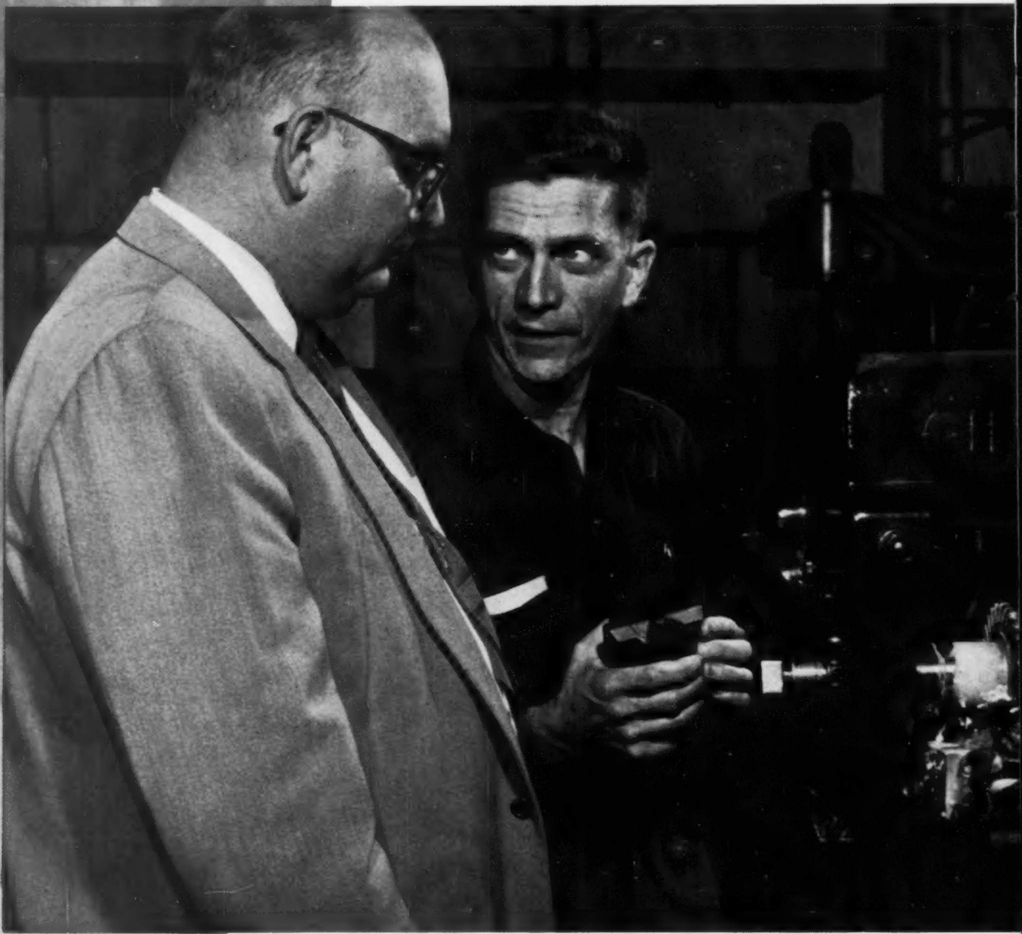
Onsrud offers components, standard machines, and machines built to your production specifications . . . all for the super high speed production milling of aluminum and related metals. May we invite your inquiry for complete information?

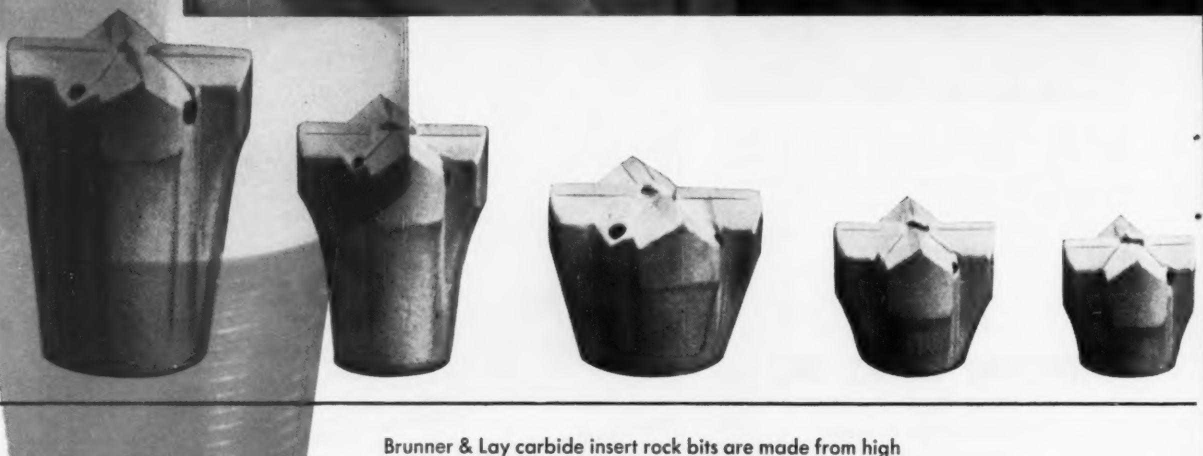
ONSRUD MACHINE WORKS, INC.
MACHINE TOOL DIVISION
7716 Lehigh Avenue
Niles 31, Illinois

DOING THINGS BETTER BY DOING THINGS DIFFERENTLY

Bit manufacturer bites off

George P. Gaunt (right) shop superintendent shows rock bit to Joseph D. Grigas, industrial lubrication specialist at Standard Oil. Joe recommended switch to SUPERLA Soluble Oil. Joe is well qualified to make such recommendations. He has 13 years experience in such work, has a degree in engineering from Illinois Institute of Technology and is a graduate of the Standard Oil Sales Engineering School.





Brunner & Lay carbide insert rock bits are made from high chrome—nickel—moly steel, Rockwell 18C-22C hardness.

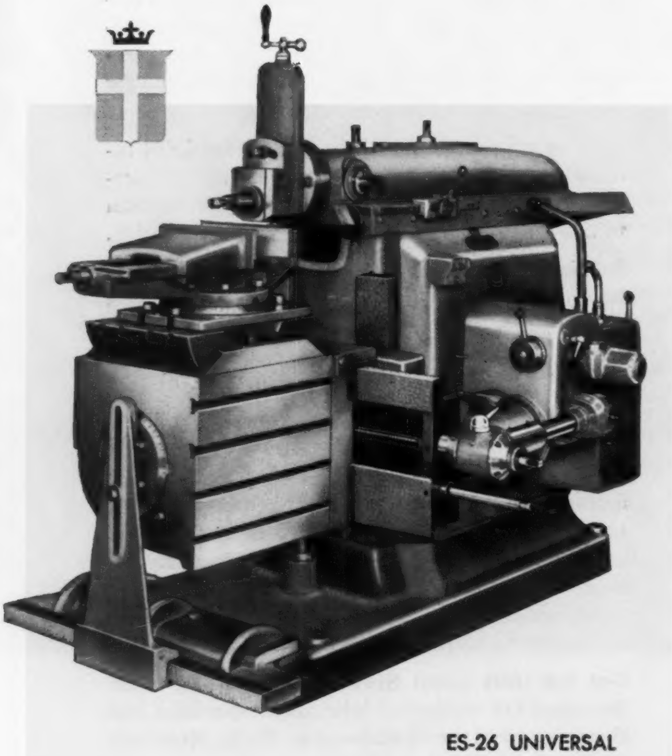
HORIZONTAL AND VERTICAL

SHAPERS

BUILT TO U.S. STANDARDS BY EUROPE'S FINEST CRAFTSMEN

The finest old world skills build life-long precision into these shapers assuring dependable production to the most exacting tolerances. Sound engineering standards and modern design are combined in these shapers offered at low initial cost.

5" VERTICAL



ES-26 UNIVERSAL

Chomienne Vertical Shaper—
5" stroke, with 12½" rotary table, automatic lubrication, power feed. A real time-saver for accurate machining of irregular shapes and forms. Low initial cost.

VMA Shapers—standard and production models . . 14" to 28" stroke . . automatic lubrication, table power rapid traverse.

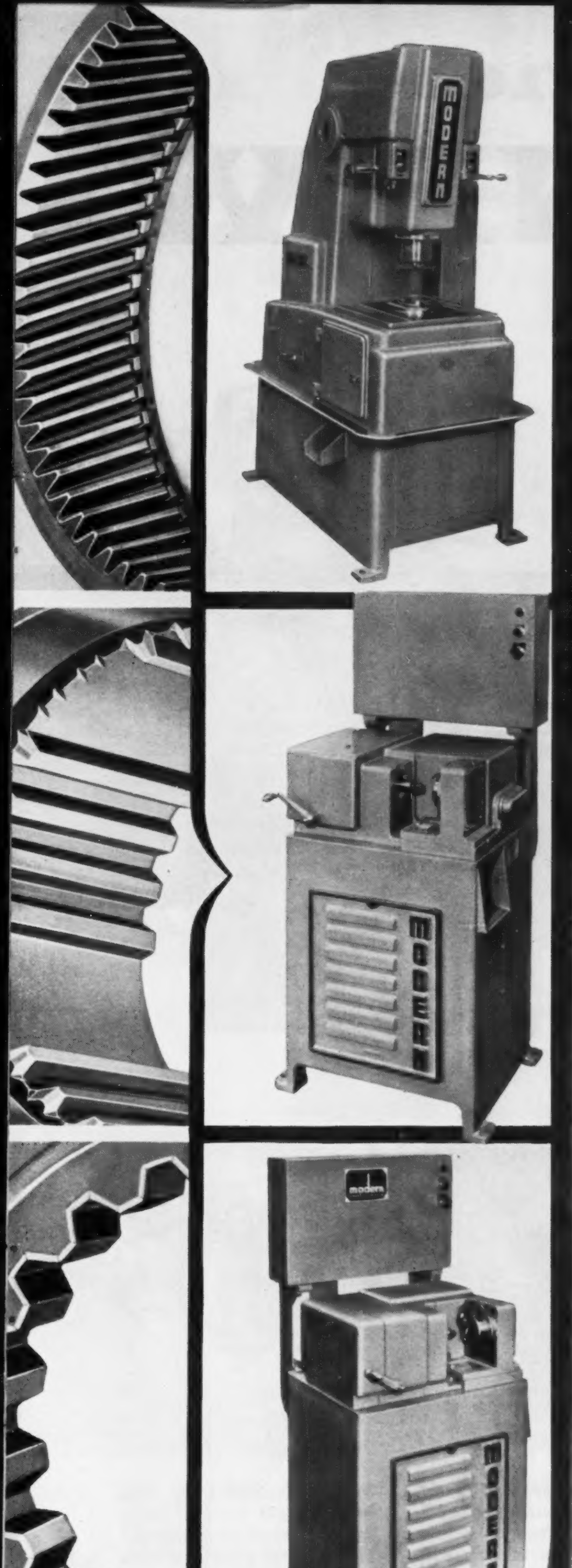
austin INDUSTRIAL CORPORATION

76-E MAMARONECK AVENUE • WHITE PLAINS, NEW YORK

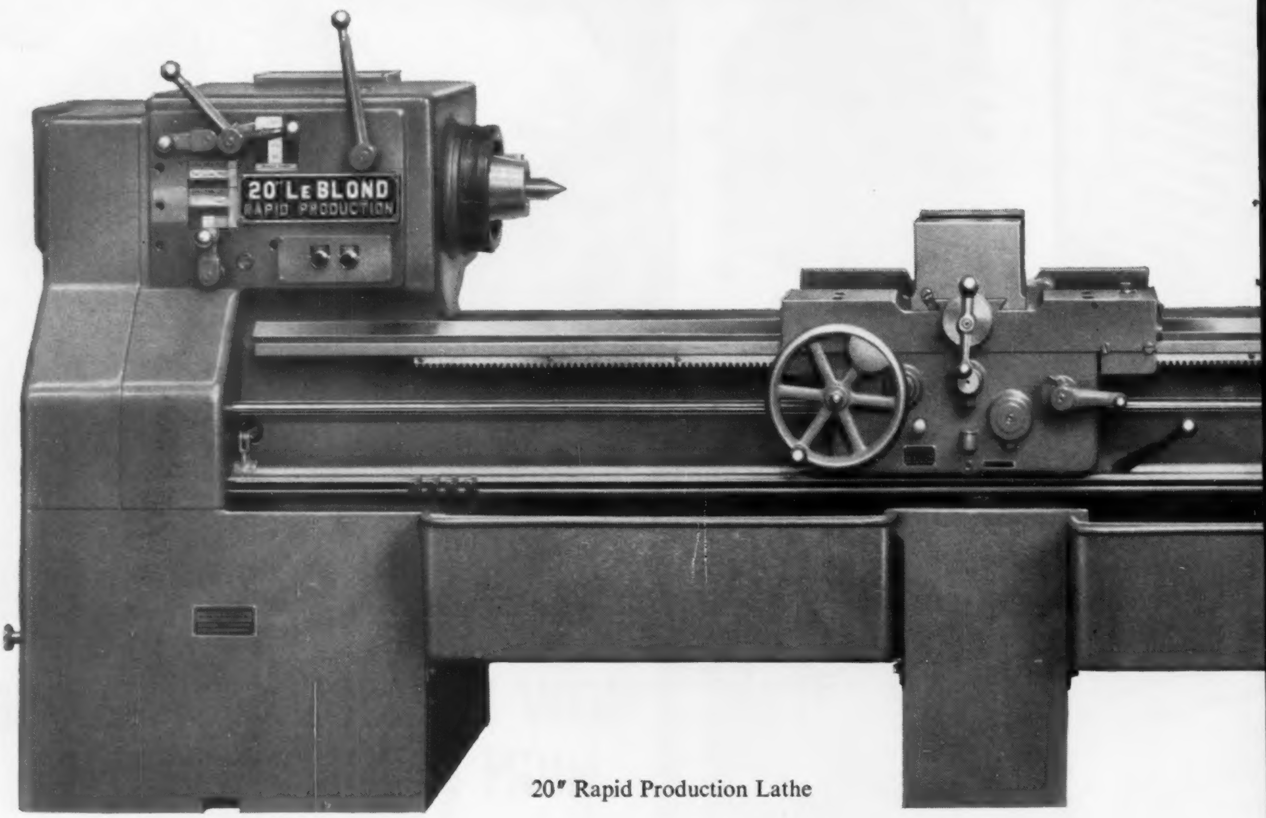
HORIZONTAL AND VERTICAL MILLING MACHINES • POWER HACKSAWS

FAST SERVICE AND PARTS AVAILABLE FROM MAJOR CITIES, WRITE FOR CATALOGS

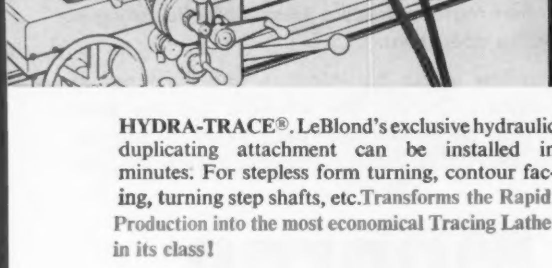
For more information fill in page number on Inquiry Card, on page 259



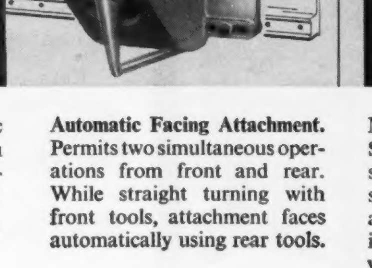
Another ALL NEW



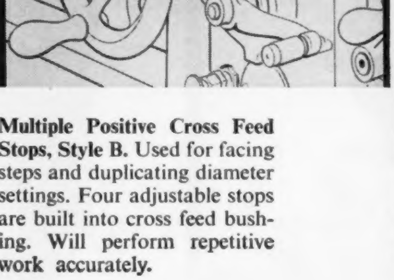
20" Rapid Production Lathe



HYDRA-TRACE®. LeBlond's exclusive hydraulic duplicating attachment can be installed in minutes. For stepless form turning, contour facing, turning step shafts, etc. Transforms the Rapid Production into the most economical Tracing Lathe in its class!

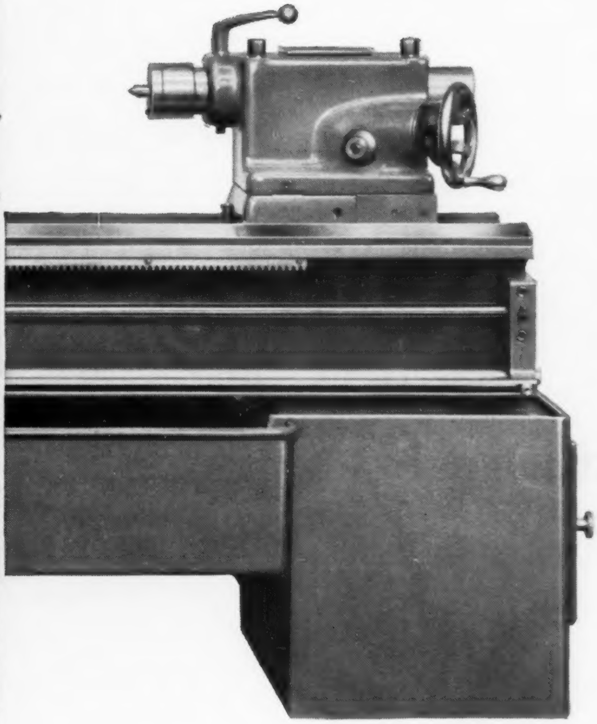


Automatic Facing Attachment. Permits two simultaneous operations from front and rear. While straight turning with front tools, attachment faces automatically using rear tools.



Multiple Positive Cross Feed Stops, Style B. Used for facing steps and duplicating diameter settings. Four adjustable stops are built into cross feed bushing. Will perform repetitive work accurately.

LEBLOND



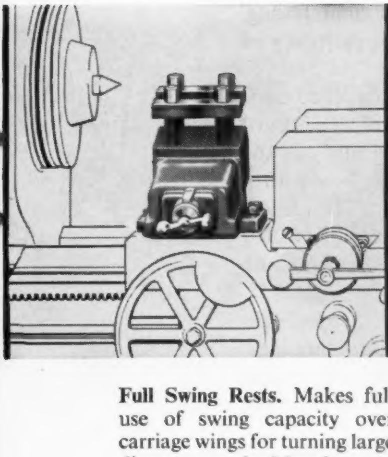
Low-cost manufacturing lathes with custom features to suit your specific turning jobs

Design your own manufacturing lathe—with the features and attachments you want. No extras to buy, only what you really need to do your job!

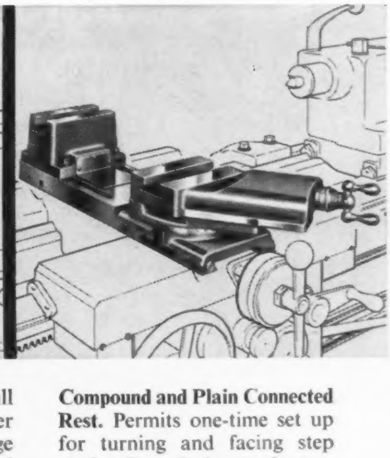
Here's how it works: The basic machine is either the new 17″ or 20″ LeBlond Rapid Production Lathe, designed from the ground up specifically for manufacturing assignments. They are *not* stripped down engine lathes. They *are* fundamentally simple, so that you can add the features you want. Ruggedly built, too, with all the basic LeBlond construction that assures dependable performance for many years.

From there on, it's your decision. First—your choice of speed ranges. On the 17″, 70 to 700 rpm or 105 to 1050 rpm. On the 20″, 57 to 600 rpm or 85 to 900 rpm. Next—your choice of any or all of these specific features: Hydra-Trace® hydraulic tracing, automatic facing, air-operated chucks, quick-acting tailstock, connected rests, taper attachments, turret tool post, cross and length stops, many more.

You'll find that with these custom features, you can design exactly the lathe you need to give you maximum production capacity per dollar investment. A lathe precisely suited to your manufacturing needs! Before you buy a manufacturing lathe, be sure to check the new LeBlond Rapid Production Lathes. Ask your LeBlond Distributor or write for Bulletin RP-220D.



Full Swing Rests. Makes full use of swing capacity over carriage wings for turning large diameter work. May be used with the compound rest for double-diameter turning on large gears, pulleys, etc.



Compound and Plain Connected Rest. Permits one-time set up for turning and facing step shafts. Rear facing tool operates alternately with front turning tool, without tool changing.

...cut with confidence

LEBLOND of Cincinnati

The R. K. LeBlond Machine Tool Company
Cincinnati 8, Ohio

World's Largest Builder of a Complete Line of Lathes For More than 70 Years

For more information fill in page number on Inquiry Card, on page 259

How to win a make-or-buy

for production men

This Avey machine is used in a jet aircraft plant on the West Coast for drilling, boring, and spotfacing the flanges and periphery of a jet engine component.

The two Aveydraulic units mounted horizontally have 12″ ram travel. The third Aveydraulic unit, mounted vertically, has 16″ ram travel and a 6-speed gear box with a speed range of 150 to 1800 rpm. The vertical column has an in and out traverse of 20″; moves to a minimum of 15″ and a maximum bolt circle of 55″.

The 60″ Electrodex table is equipped with a master index ring with two rows of bushings, 96, 49, and 8 indexes respectively. The three heads can be programmed to the indexing of the table.

Another example of how Avey combines standard units to meet special production requirements.

LARGE swing...medium cost ...with new Axelson lathes

Production managers who've been wishing they could afford a larger lathe now have a chance to swing really big ...at medium cost...with new Axelson large-swing lathes.

Axelson's 44", 48" and 60" lathes are ready to go to work on the job of producing profits from big, odd-shaped pieces that ordinary lathes can't handle.

Operators will take pride in the flexibility of these lathes, which can take on the biggest pieces in the shop... then swing quickly into action on smaller jobs. Big, healthy bites and small, precision cuts are all in a day's work.

Quick shifting of the 24-speed headstock produces spindle speeds from 6 to 750 r.p.m., forward or reverse, in true geometric progression.

Tailstocks are rugged one-piece castings that absorb the twist-turn punishment of heavy machining... eliminate inaccuracies caused by bolt stretch. Movement of the two-speed tailstock spindle can be fast or slow, easily controlled by the operator to meet his needs.

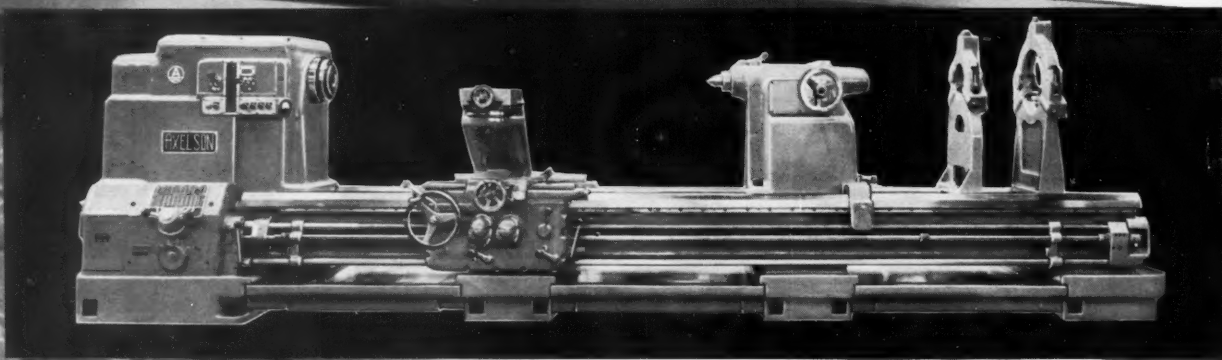
Two levers control all 81 feeds and 45 leads. Apron-located feed controls are positive-action, serrated-tooth type, requiring only light finger pressure for engagement.

For more information about these large-swing lathes ... at medium cost ... call your nearest Axelson representative or write for Bulletins M7-5508 (44"), M7-5510 (48"), and M7-5509 (60").

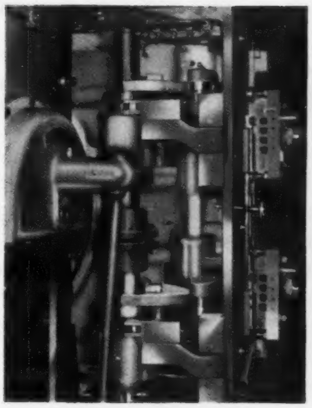
AXELSON LATHES

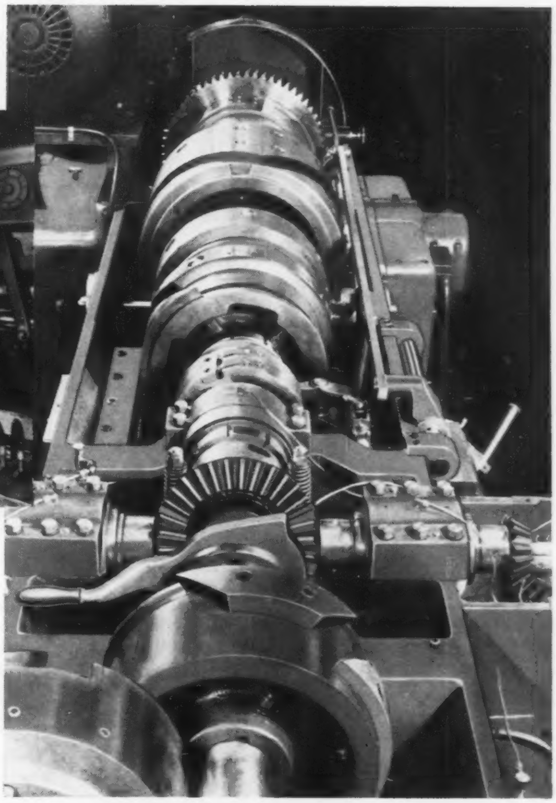
AXELSON MANUFACTURING COMPANY

Division of U. S. Industries, Inc.
6160 S. Boyle Avenue. Los Angeles 58, California



Standard-Duty Model 6049 – 60" swing, 40 hp. (above)
Standard-Duty Model 4836 – 48" swing, 60 hp.
Heavy-Duty Model 4431 – 44" swing, 75 hp.



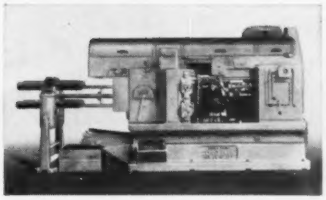


Conomatics Provide Radial Screw Adjustment of Forming Tool Slides

● Models $2\frac{5}{8}$" LA, $3\frac{1}{2}$" AD, 5" KL, and $5\frac{1}{4}$" KR Conomatic Four Spindle Bar Machines are equipped with a number of quick job-change features. One of these is the all-position end attachment drive for the mounting of endworking opposed spindles in all positions, with independent feed to as many as three opposed spindles on a single setup.

Another feature that is of considerable importance in tooling up is the radial screw adjustment of all sideworking slides. Trial cuts may be taken to correct diameters with form tools without changing the clamped positions of the form tool holders.

All Conomatic quick changeover models are equipped with dial adjustment of the working stroke of all tool carrying slides. Besides the Four Spindle machines there are three quick change Six Spindle models in $\frac{9}{16}$", 1" and $1\frac{5}{8}$" sizes. Write, wire, or phone for literature.



Conomatic

CONE AUTOMATIC MACHINE COMPANY, INC., WINDSOR, VT., U. S. A.

Precision Requires Gages

THAT'S WHY FEDERAL OFFERS

Standard
Model 149P-20
1" to 3"

Standard
Model 49P-1
0" to 3"

Model 149P 611

Just *any* gage is not good enough when you want to check a dimension for accuracy. Some dimensions require a higher degree of accuracy than others. And some dimensions cannot be reached directly. Still others need ranges or adjustments to give greater gage capacity.

Inside and Outside CALIPER GAGES

Ideal for measuring difficult dimensions. Specially shaped arms of various lengths can be designed to reach inaccessible spots or get around obstructions.

Odd Shaped Jaws for Unusual Applications

Limitless variety of jaw shapes permit measurements impossible with any other type of gage.

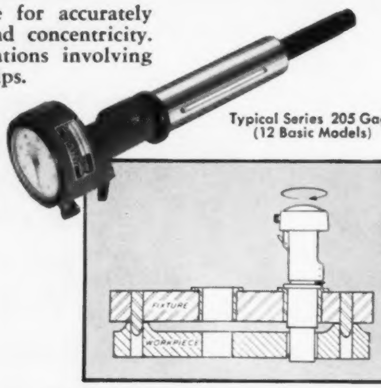
HOLE LOCATION GAGES

Series 205 Gages provide for accurately checking hole location and concentricity. Also adaptable to applications involving hole and surface relationships.

Squareness and location of holes in three mating parts of pump housing are checked to determine alignment within .0001".

Two small and one large hole are checked for parallelism with each other.

Typical Series 205 Gage
(12 Basic Models)



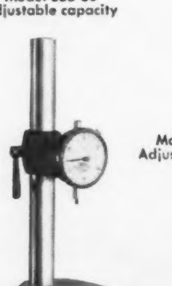
Hole location with respect to a predetermined reference and squareness of hole axis to a locating fixture.

BENCH TYPE THICKNESS GAGES and Small Comparators

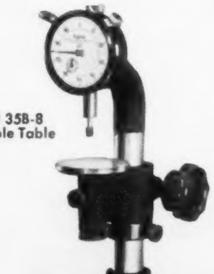
Model 691B — Deep throat for ample clearance. Weight for compressible materials, applied directly through Indicator spindle assures uniform measuring pressure.

Model 57B-1
Long 1" Range

Model 35B-30
Adjustable capacity



Model 35B-8
Adjustable Table



to Suit the Job...

SUCH A VARIETY OF GAGES!

It's easy to check a dimension with a Federal Gage — and it's the quickest and least expensive way. Just call Federal and get the *right* gage for your job.

FEDERAL PRODUCTS CORPORATION
7117 EDDY STREET, PROVIDENCE 1, R. I.

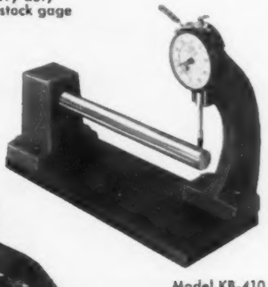
WHATEVER YOU NEED IN GAGES

Ask **FEDERAL** *First*

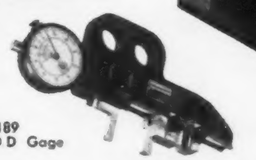
THICKNESS GAGES

Many styles and sizes, for portable and bench use.

Model 644
Heavy duty sheet stock gage



Model KB-410
Deep Throat, Adjustable



Model 22P-189
Adjustable I.D.—O D Gage

Model 22P-20
Deep Throat, Long Range

Model KP-120
Deep Throat, Portable

Model 22P-10

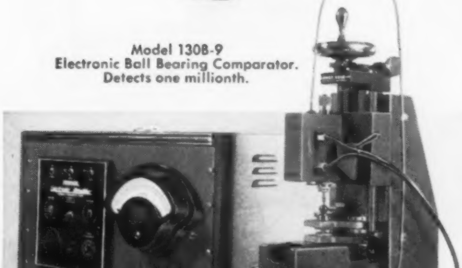
Model 26P-7
Hand-grip

OVER 10 TYPES OF COMPARATORS

Model 130B
Electronic Comparator
0" to 7½"
Magnifications to 15,000x

Model 120B-1
The "Microset" Comparator
0" to 8"

Model NB-60
General purpose Comparator



Model 130B-9
Electronic Ball Bearing Comparator.
Detects one millionth.

Model 136
I.D. — O.D. Electronic Master Comparator
Detects one millionth

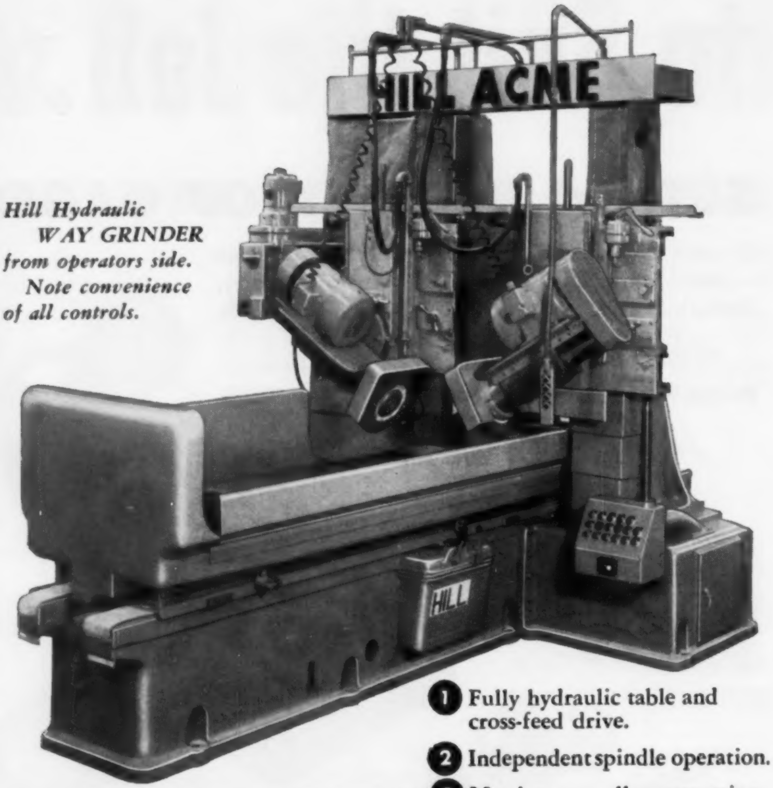
MANY OTHER TYPES

Send for Catalog illustrating world's most complete line of Dial Indicator Gages.

GAGES CAN BE SPECIALLY MODIFIED TO SUIT

HILL double housing WAY GRINDER for accurate grinding of V's, Flats and Angles

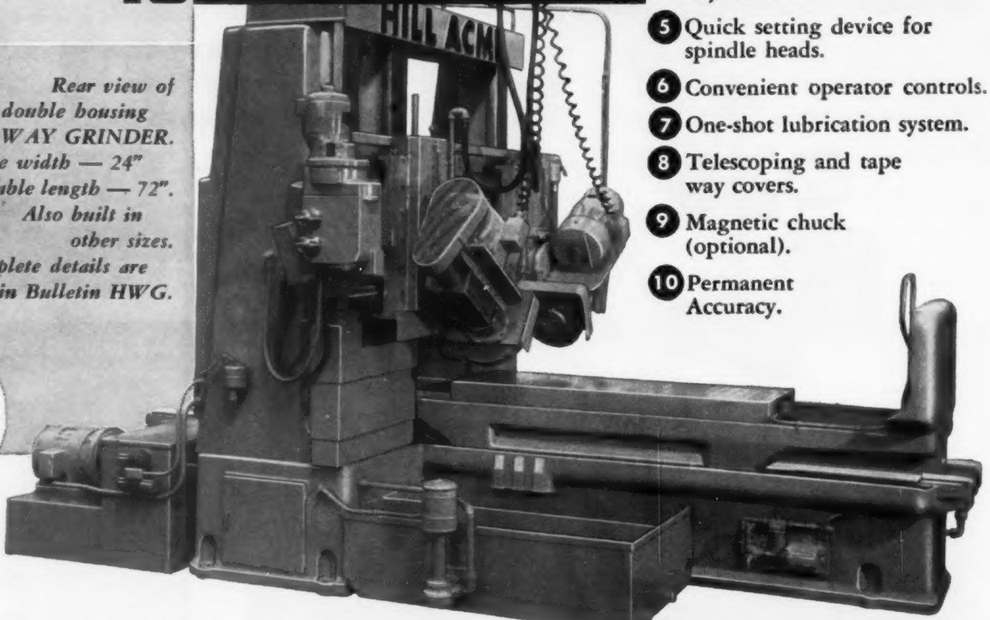
Substantial Savings (up to 50%) over previous methods.



Hill Hydraulic WAY GRINDER from operators side. Note convenience of all controls.

10 points worth considering

1. Fully hydraulic table and cross-feed drive.
2. Independent spindle operation.
3. Massive over-all construction.
4. Rapid traverse and fine feed adjustment.
5. Quick setting device for spindle heads.
6. Convenient operator controls.
7. One-shot lubrication system.
8. Telescoping and tape way covers.
9. Magnetic chuck (optional).
10. Permanent Accuracy.



Rear view of HILL double housing WAY GRINDER. Table width — 24" Table length — 72". Also built in other sizes. Complete details are given in Bulletin HWG.

HILL ACME TOOLS FOR INDUSTRY

THE HILL ACME COMPANY

1209 WEST 65th STREET • • • CLEVELAND 2, OHIO

"HILL" GRINDING & POLISHING MACHINES • HYDRAULIC SURFACE GRINDERS • ALSO MANUFACTURERS OF "ACME" FORGING THREADING • TAPPING MACHINES • "CANTON" ALLIGATOR SHEARS • BILLET SHEARS • "CLEVELAND" KNIVES • SHEAR BLADES

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ARMSTRONG

Drop Forged CLAMPS

LEADERS IN THE DROP FORGED CLAMP FIELD

. . . in design, machining and strength; in completeness of line in both sizes and types.

Designs are based on a full knowledge of clamp uses and requisites. Drop forging assures die-perfect form, texture toughness and freedom from structural faults. Maximum stiffness is attained by a discerning selection of steels with accurate controlled heat-treating, tempering and testing.

For dependability and long useful life, specify and standardize on ARMSTRONG Drop Forged Clamps.

EXTRA DEEP THROAT "C" CLAMPS

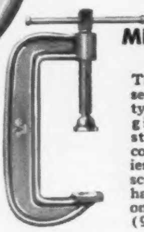
Provide extra clearance required for some work. Extremely stiff for weight. Screws and hubs are accurately machined and aligned with ground seats; have sliding pin handles and free-acting swivel caps on point. Bodies have smooth sandblast finish.
(11 sizes to 12" opening)

Write for new ARMSTRONG General Catalog showing almost 5000 industrial tools.

ARMSTRONG BROS. TOOL CO.
5213 W. ARMSTRONG AVE. • CHICAGO 30, U.S.A.

HEAVY DUTY "C" CLAMPS

Universally recognized as strongest "C" clamps made. Longer hub holds screw alignment against terrific side strain; permit tighter clamping and multiplies thread friction against loosening. Alloy steel screws are hardened at point to prevent upsetting. Ground seat.
(8 sizes to 12" opening)

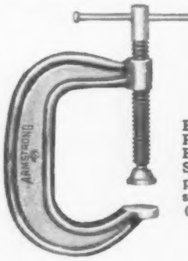


MEDIUM SERVICE "C" CLAMPS

The design and careful selection of steels in this type clamp combine to give it maximum strength and stiffness consistent with convenient weight. Heat treated screw with sliding pin handle and swivel cap on point. Ground seat.
(9 sizes to 18" opening)

TOOL MAKERS "C" CLAMPS

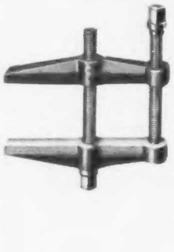
Quality steels, drop forged, heat treated and accurately machined with ground seats. Drop forged screws have both "wing nut" handle for convenience and square necks for tight setting with a wrench. Either "plain" or "swivel" screw types.
(Four sizes: 1", 2", 3" or 4" maximum opening)



SPATTER RESISTANT WELDERS "C" CLAMPS

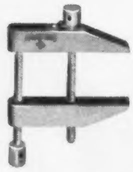
Extra Deep Throat Pattern (see above). Body, Swivel and Screw are cadmium plated over all to resist welding spatter.
(8 sizes Capacities to 12" opening)

MACHINISTS' CLAMPS



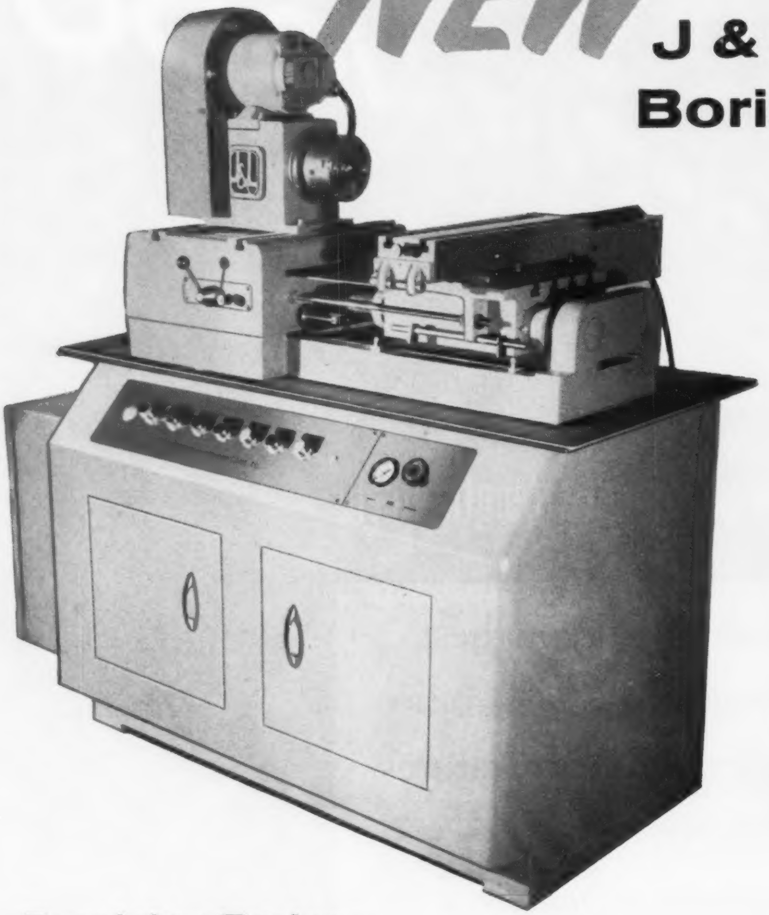
Jaws drop forged, carefully machined and hardened, are extra heavy; will not bend or spring on a short bite and are faced true. Will grip non-parallel surfaces because the under face of the center screw is convex, fitting into a concave seat for tilting.
(Four sizes: Capacities to 4¼" opening)

PARALLEL CLAMPS



Carefully machined from selected grade steel and hardened. Particularly suited for holding work together when drilling or tapping. Rounded jaw ends increase clearance in close quarters. Spring clip holds loose pin in alignment while tightening or loosening.
(3 sizes: Capacities to 2½" opening).

NEW J & L Precision Boring Machine



Precision Boring– Turning – Facing at LOW COST

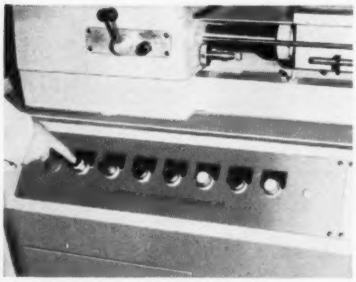
Jones & Lamson fills a long-felt need with this new J & L Precision Boring Machine. Now, it is possible to have truly precise turning, boring and facing operations at truly low cost.

This new machine is ideal for long *or* short runs . . . is extremely versatile . . . is easy to set up . . . and spindle runout is less than .000020″. Max. swing is 10″ dia. and max. bore is 3″ dia.

Write today for complete information.

Base will accommodate *two spindles* for rough and finish boring, simultaneous facing and boring, or for boring two holes at once.

Work table feed is actuated with variable hydraulic check unit. Adjustable stops are easily set for length of rapid traverse and feed strokes.



Push button cycling — manual or automatic.

JONES & LAMSON

JONES & LAMSON MACHINE COMPANY, Dept. 710, 512 Clinton Street, Springfield, Vt., U. S. A.

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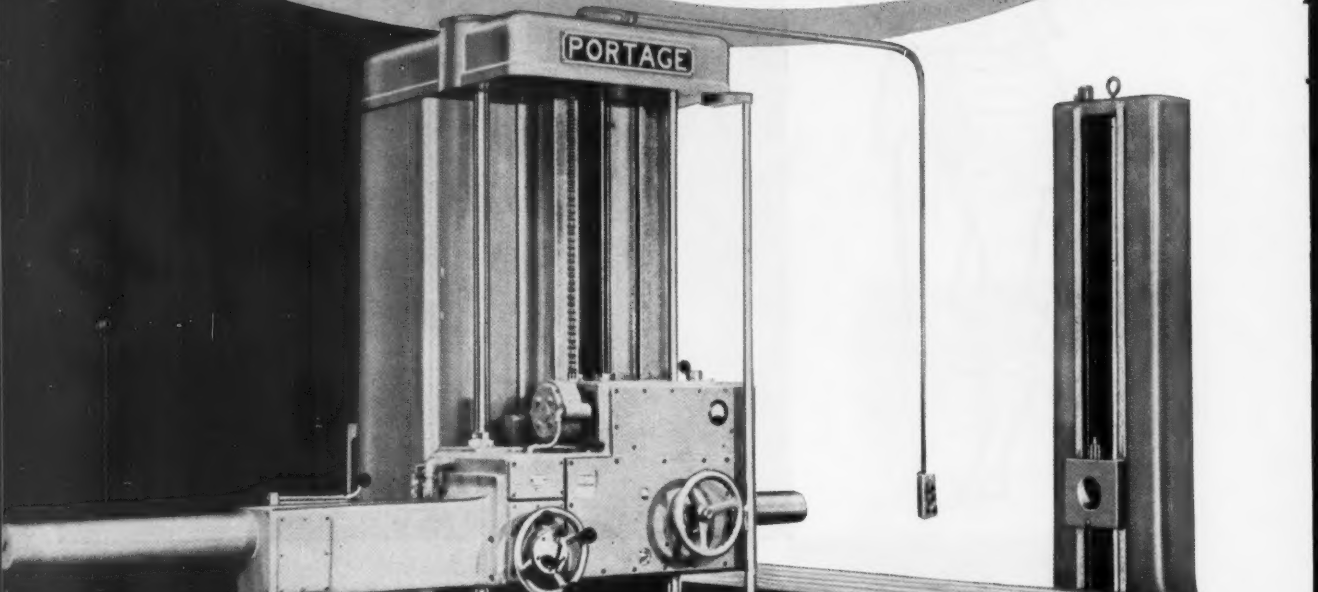
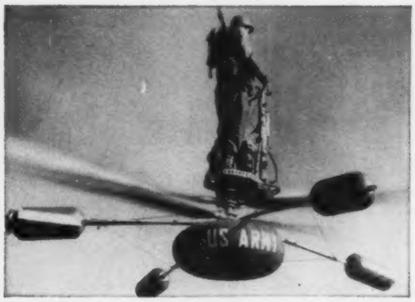
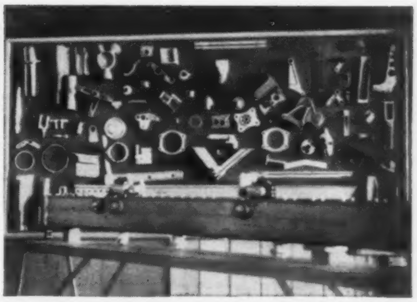
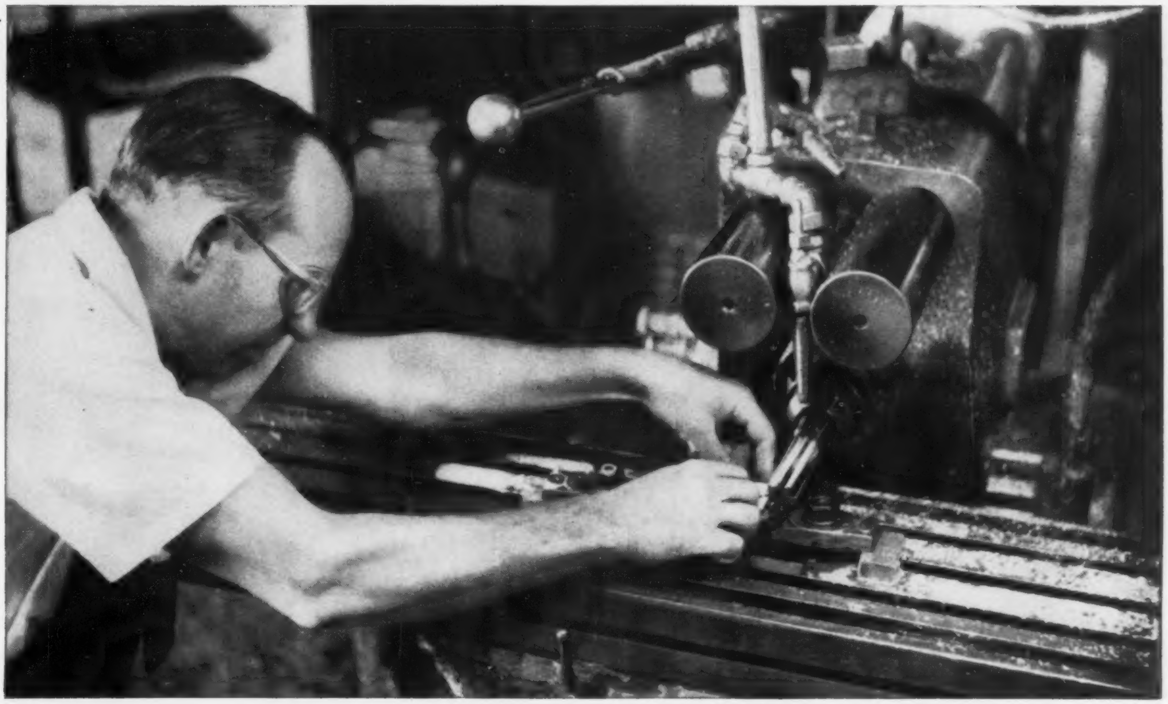




◀**Aerocycle,** a one-man helicopter now being tested by the U. S. Army, is one of the many aircraft for which Aeroaffiliates machines precision parts.

Some Examples of Aeroaffiliates' Work. All require fine tolerances and excellent finish. All were made with the help of Cities Service Chillo Cutting Oils. ▶





"Fine Tolerances! Excellent Tool Life! With Cities Service Chillo Cutting Oil"

In probably no other machining operation are the tolerances so fine, the requirements so demanding as in aircraft work . . . especially when it's for the U. S. Army or Air Force.

But it is on such work that Aeroaffiliates, Inc. of Fort Worth, Texas, has become famous.

Every day, Aeroaffiliates employees must work with tolerances as fine as .0001, and their products must have an unusually good finish . . . so good that they are measured by a special gauge before the aircraft industry will accept them.

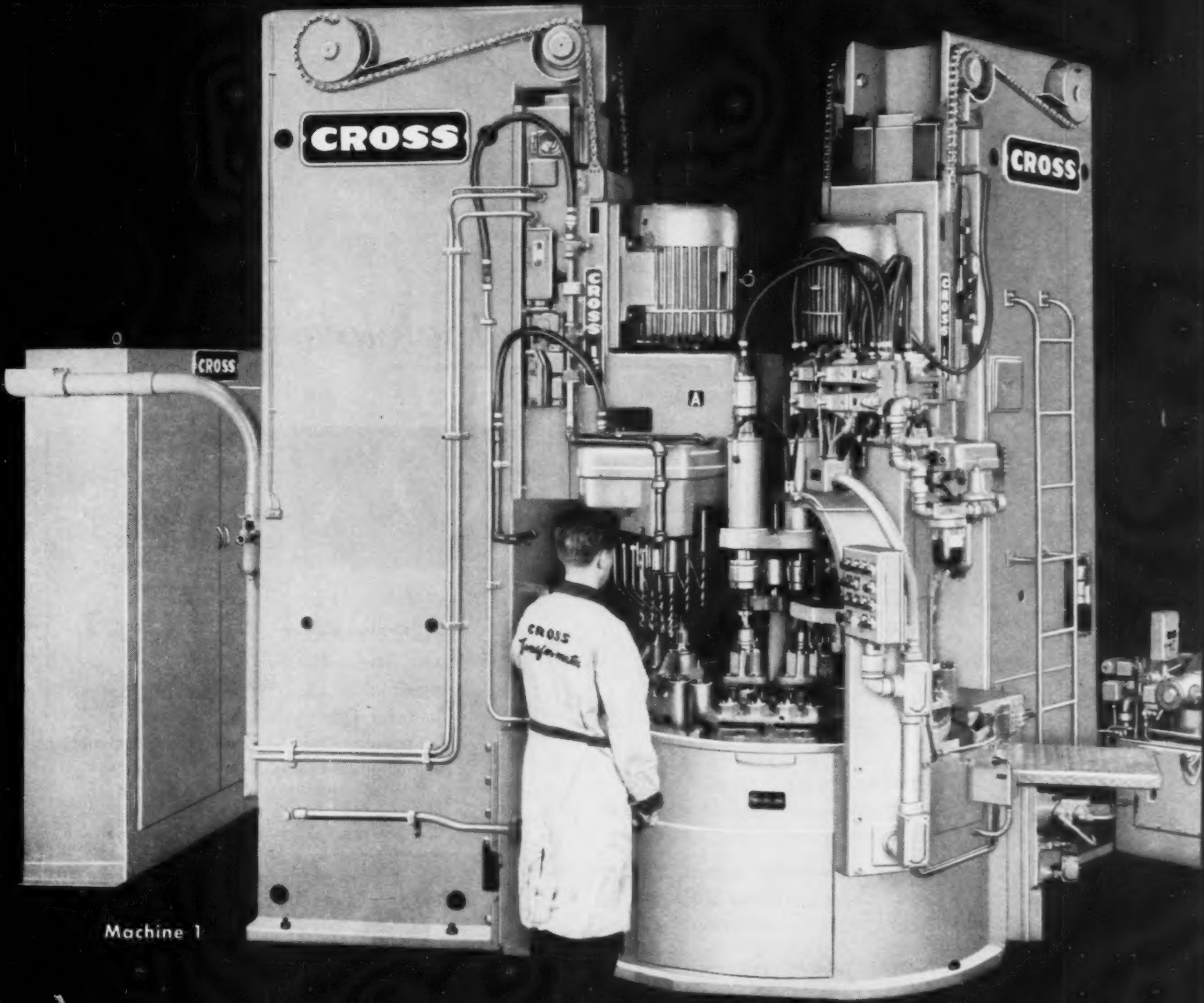
Obviously, this could play havoc with tool life . . . "but thanks to Cities Service Chillo Cutting Oils, tool life and finish are the best ever," says Aeroaffiliates. "These cutting oils are equalled only by the help we receive from the Cities Service Lubrication Engineer, a man whose knowledge and help we greatly value."

Whatever *your* type of machining operation, there's a Cities Service cutting oil tailored precisely for it . . . and a Cities Service Lubrication Engineer to help you choose it. Call him in this week. Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

For more information fill in page number on Inquiry Card, on page 259



Machine 1

- ★ 800 pieces per hour at 100% efficiency.
- ★ Four parts machined in each station.
- ★ Machine 1 drills and reams rocker shaft hole; forms oil groove; drills one oil hole. Machine 2 drills, chamfers and taps adjusting screw hole; drills, counterdrills and spotfaces second oil hole.
- ★ Push button controlled power wrenches operate fixture clamps.
- ★ Cross "building block" construction provides flexibility for part design changes.
- ★ Complete interchangeability of all standard and special parts for easy maintenance.
- ★ Other features: Construction to JIC standards; hardened and ground ways; hydraulic feed and rapid traverse for drilling and reaming; individual lead screw feed for tapping; automatic lubrication; pre-set tooling throughout.

Model	Column	Arm	Speeds	Feeds	Motor

Carlton

producer of the original low hung drive

Check this exclusive combination of Carlton advantages:

Low hung drive: created by Carlton, widely copied but never duplicated.

Wide selection: 5 models and many arm and column sizes.

Greater capacity: broad range of speeds and feeds; practically any combination of tap leads available.

Programming, pre-selector, partial pre-selector or manual speed-feed control.

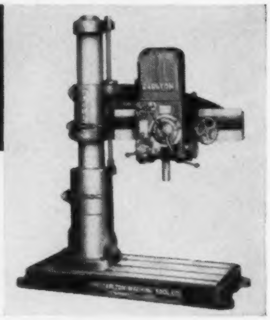
Super-precision column clamp; 360° clamping for 20% more rigidity, greater accuracy.

3-unit power clamping: arm, head and column, for easier and more economical operation.

Positive tooth feed clutch: provides constant feed to the spindle regardless of density of metal.

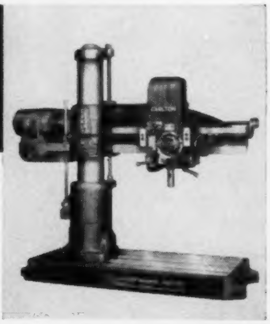
Easy, economical maintenance: only one friction clutch; 100% interchangeability of parts.

OA



A versatile radial drill with hole drilling range from $\frac{1}{8}''$ to $1\frac{3}{4}''$ diameter. Offers many of the exclusive Carlton design, construction and operating advantages shown at left.

1A



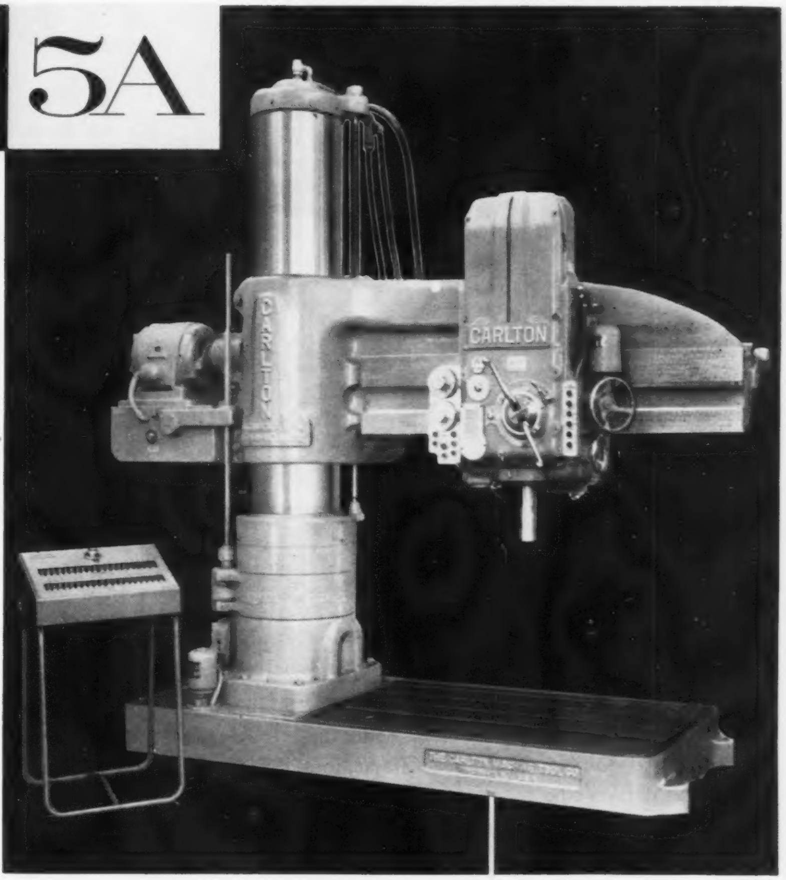
A medium duty radial drill with a hole drilling capacity of $\frac{1}{8}''$ to $2\frac{1}{4}''$ diameter. Like all Carlton radial drills, the 1A has the super-precision column clamp and the anti-friction mounted head.

Model	Column diameters	Arm lengths	Speeds No.	Speeds Range	Feeds No.	Feeds Range	Motor recommended
0A	9"	3'-4'	9	20 to 1	4	.006-.020	3-hp
1A	9" 11"	3'-4' 3'-4'-5'	12	25 to 1	6	.006-.025	5-hp 5 or 7½-hp
3A	13" 15" 17"	4'-5' 4'-5'-6' 5'-6'-7'	36	100 to 1	18	.004-.125*	7½, 10, 15 or 20-hp
4A	19"	6'-7'-8'	36	100 to 1	18	.004-.125*	15, 20 or 25-hp
5A	22" 26"	7' to 10' 8' to 12'	36	100 to 1	18	.004-.125*	20, 25 or 40-hp

*8, 11½, 14 and 18 threads per inch are standard, with various other combinations available.

presents the modern design radial drill

3A 4A 5A



The 3A, 4A and 5A Carlton radial drills offer you a choice of four speed-feed controls:

Programming for pre-selecting speeds and feeds for an entire drilling program including as many as 20 or 30 operations.

Pre-selector for setting speed and feed for the next operation while machine is still under cut.

Partial pre-selector selects 36 spindle speeds; feeds shifted manually.

Manual to take advantage of Carlton's centralized push button control.

In addition, these three models give you all the exclusive Carlton advantages shown on the opposite page. No wonder leading machine tool buyers say that Carlton is the ONE *modern design* radial drill. The Carlton Machine Tool Co., Cincinnati 25, Ohio.

Carlton

SPECIALISTS IN RADIAL DRILLS

For more information fill in page number on Inquiry Card, on page 259

For more information fill in page number on Inquiry Card, on page 259

- **Missile Program Massive**
- **Operation Thermal Thicket**
- **Operation Hades**
- **Washington Briefs**

Keeping up with Washington

By Loring F. Overman

BECAUSE of the guided missile, industry is being asked to take a new look at the defense program. Defense chiefs are pointing out that military science, having progressed from surface to atmosphere, is now ready to move on into the stratosphere. For the machine tool industry—progenitor of industrial equipment and military materiel—the change-over can again be revolutionary.

Major adjustments will come first in the aircraft industry. Authority for this forecast is Major General David H. Baker, Director of Procurement and Production, Air Materiel Command. General Baker expects deliveries of airframe and missile frame weight to total 6.5 million pounds per month by the end of 1957 . . . dropping to 2.5 million pounds per month by the fiscal year 1959-1960. At that leveling-out point, the shift to missiles should be about complete.

Surplus space in aircraft plants, accompanied by surplus facilities and surplus workers, will result. The change will also affect companies that manufacture current model engines and other specialized equipment, as well as the machines which produce these units. Projection of industrial thinking, to anticipate these leveling-off problems and to be ready with solutions, is the General's suggestion.

Operation Thermal Thicket

Many of tomorrow's defense production problems are being previewed through projects of the Manufacturing Methods Branch, Industrial Resources Division, Air Materiel Command. By means of pilot projects under contract in several fields, the Air Force is seeking solutions to problems of high-heat metals, electronics, materials fabrication, machine tools, processes, and plastics. Temperature-resistant metal projects have a high current priority. Included are studies of manufacturing methods involving alloys of titanium—titanium casting, forging, and extrusion. Machine tool projects deal principally with developing and improving machines to handle the new and harder metals that will be specified for aircraft and missiles now in the drafting stage.

Operation Hades

Despite progress being made by the Air Materiel Command, aircraft industry spokesmen are pressing other government researchers for answers to the problems of "hot metal." The Office of the Assistant Defense Secretary for Research and Engineering has been told that metals capable of withstanding temperatures of from 2000 to 3500 degrees F. must be anticipated by 1967. The Aircraft Industries Association has named half a dozen fields where a great deal of research and development activities are needed. Involved are machines to fabricate the new materials, special instruments, strain gages, high-energy heat sources, better refrigeration units, skin cooling methods, engines, fuels, and electrical equipment.

Machinery Outlook Studied

Although concerned over unique problems of a new defense age, the Department of Defense still appreciates the importance of keeping today's military muscles strong. Congress learned in mid-May that the mobilization program no longer emphasized expansion of facilities in an emergency. Instead, the Department is endeavoring to maintain production facilities in a constant state of readiness and adjusted to technological changes.

About machine tools, the DOD report to Congress observed: "In order to improve management of its machine tools in peacetime and to provide more accurate data for mobilization planning, the Department of Defense has undertaken a detailed inventory of the metal-working equipment owned by the military departments. Of the 350,000 pieces currently estimated to be held by these departments, 280,000 have been inventoried, having an acquisition value of approximately 3 billion dollars. The inactive equipment totaled 64,000 pieces on June 30, 1956."

Washington Briefs

- Congress has been asked to consider a joint Senate-House resolution to set aside not less than 25 per cent of Defense Department prime contracts for small business firms. Senator Sparkman, Small Business Committee Chairman, noted that small business received 25.3 per cent of defense contracts in 1954; 21.5 per cent in 1955; 19.6 per cent in fiscal 1956; and only 16.7 per cent in fiscal 1957.
- The Senate Armed Services Committee has asked the Secretary of Defense to "do something" about former government employes who accept employment that puts them in a position to influence the placement of defense contracts. A subcommittee report said that 108 former officers holding ranks of brigadier general, rear admiral, and above have received security clearances that permit them to represent their companies or perform duties in connection with defense work.
- The Senate, in mid-May, passed and returned to the Senate-House conference committee, a Department of Commerce appropriation bill that restores the money needed to operate twenty-five industry divisions of the Business Defense Services Administration. The House had cut out this item in trimming the Commerce Department estimate of requirements for fiscal 1958.

For more information fill in page number on Inquiry Card, on page 259

Machinery
JULY 1957

Aircraft Building— An Eight-Billion-Dollar Industry

FEW industries have had as meteoric a rise as the aircraft industry. In 1909, only one military plane was built. Figures are not available as to the number of civilian planes built that year, but they were few indeed, as only twenty-nine were constructed three years later when sixteen military planes were turned out. Contrast this low production with a total of 96,318 planes, all military, in 1944, which hit the all-time production zenith.

The number of planes to be built this year will be considerably smaller than the all-time high, say, approximately 12,000 to 13,000 planes. But there is a vast difference in the size and weight of aircraft today in comparison with the fighters, bombers, and transport planes produced at the end of World War II. For example, in 1944, heavy bombers had an airframe weight of 49,000 pounds; today, 170,000 pounds. All-weather fighters weighed 10,000 pounds; today, from 12,000 to 20,000 pounds. Heavy transports weighed from 20,000 to 60,000 pounds; now, up to 111,000 pounds. In addition to planes, the aircraft industry is today heavily engaged in turning out guided missiles.

The total sales of aircraft in 1957 will amount to over $8,000,000,000, and similar amounts of business can be anticipated for the industry in the years immediately ahead. Business conditions, therefore, are not a matter of concern. The problems are those of originating airplane designs to keep pace with changing scientific concepts, of producing materials that will meet the new concepts, and of developing processes for machining and fabricating the new materials. There is, of course, today's omnipresent problem of finding a sufficient number of scientists, engineers, and qualified production men to carry out projected programs.

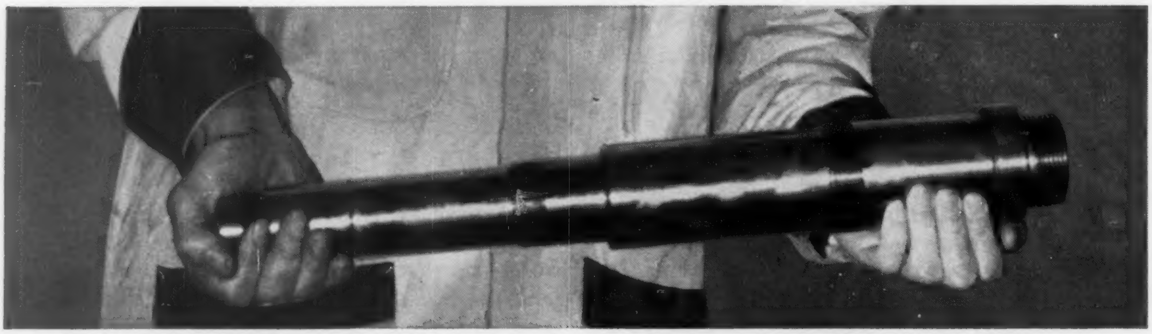
Manufacturing processes in the aircraft industry undergo more fundamental changes year after year than have probably occurred in any other industry in the same span of time. This is obviously due to the rapidly changing ideas about aircraft design. First, wood and fabric planes with comparatively simple water-cooled engines; then all-aluminum airframes and the complicated piston type air-cooled engines; and now, planes constructed of metals that withstand the stresses and temperatures of supersonic high-altitude flying—planes equipped with jet engines.

That the aircraft industry has always been capable of solving its production problems has been indicated by the many articles published in MACHINERY since the first Aircraft Production Number was published in 1938. The present special number continues to prove in the following pages that the production men of the aircraft industry are really "on their toes!"

Charles O. Herb

EDITOR

Machining Costs Cut 25%
by switch to NEW RYCUT 50

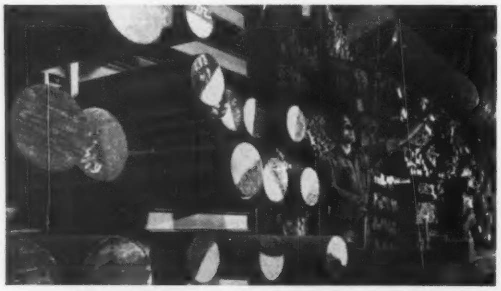


Logan Engineering Co. report shows how you can save up to 30% with a Ryerson leaded alloy

THE PROBLEM—This Chicago manufacturer of precision lathes faced a tough production problem from a time and cost standpoint. Lathe spindles have to be tough and hard with high wear resistance—so the steel Logan originally used was SAE 52100.

But the spindles were turned down and center-drilled from the solid to hole sizes as large as 1⅜". And ID's had to be accurate and free from scoring along the entire length of the spindles. 52100 provided the required mechanical properties but was slow cutting and created production difficulties and a high scrap rate.

Needed: A *free-machining* steel that would develop the high hardness levels, the toughness and wear strength required for the application.



THESE LARGE ALLOY STOCKS . . . also carbon and stainless steels in every shape and size, are in stock at Ryerson. Also call Ryerson for reinforcing steel service, industrial plastics, machinery and tools, etc.

THE SOLUTION—Logan engineers had long been on the lookout for a steel that would solve their production problems so they were eager to try New Rycut 50 when this Ryerson 50-carbon alloy steel with a controlled lead addition was suggested by Ryerson metallurgists.

New Rycut 50 was a success from the start! Now, after two years, Harry Peterson, Logan plant superintendent, reports: "New Rycut 50 has saved us a consistent 25% of our former costs in the production of lathe spindles. Rycut's uniform machining and hardening properties have reduced scrapped parts to a minimum and the steel has proved satisfactory in every way."

This is just one of many case histories in our files on the steels in the Rycut series—New Rycut 50, Rycut 40 and Rycut 20. Actual performance records show machinability increased as much as 50% . . . tool life lengthened as much as 300% when a Rycut steel is used in place of a standard alloy of comparable mechanical properties.

To get further information on these great new cost-cutting steels or for quick shipment of any steel requirement, call or write your nearby Ryerson plant.

RYERSON STEEL

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • WALLINGFORD, CONN. • PHILADELPHIA • CHARLOTTE • CINCINNATI CLEVELAND • DETROIT • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE

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Convair F-102 All-Weather Interceptor

17TH AIRCRAFT PRODUCTION NUMBER

Vol. 63 No. 11 MACHINERY July 1957

THE AIRCRAFT INDUSTRY'S FANTASTIC FUTURE PROBLEMS

MILITARY necessity rather than consumer preference has generally dictated the direction taken in aircraft construction. Up until 1950, manufacturing capability in the industry was well ahead of engineering design. The shop could build anything that the engineering department conceived. But, at "MACH 1" (the speed of sound), high-density materials, sturdier and stiffer structures, exactingly close tolerances, and complicated electronic equipment became production necessities. From that point, two roads—one marked "Engineering Capability" and the other, "Manufacturing Capability"—have diverged until today the engineer's cherished desire for complete freedom of design is fettered by the ability of the aircraft plant to turn out the product.

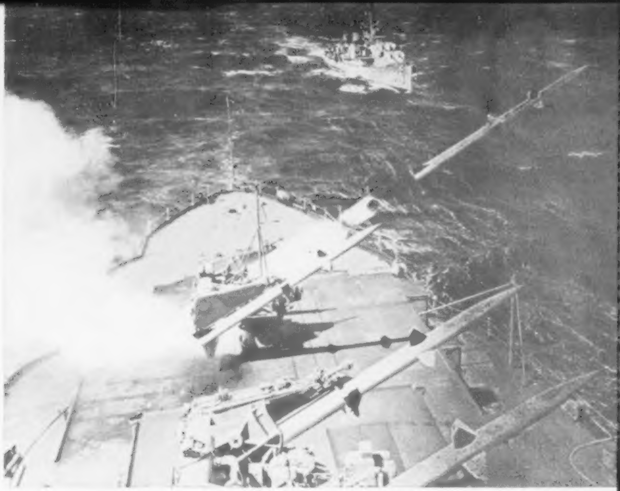
As engineering capability gained ground faster than manufacturing capability, productivity has lowered. More and more people are required to build the products that the military services are demanding and the engineers are designing. With the advent of the modern weapon system and its attendant electronic complexity, engineering technology has increased fantastically. This is best dramatized by the fact that today the aircraft industry has approximately one engineer to every seven other employes. Ten years ago, the ratio was one engineer to sixteen other employes.

Until fairly recent times science and industry had a rather loose relationship. But, progress in many industries has been so swift and has carried so far into the frontiers of human knowledge that the union of science and industry has become both inevitable and inseparable. Congress appropriates billions of dollars annually just for research and development to assist and stimulate the aircraft industry's quest for ever greater technological development to meet national defense needs. Much of this money goes for advanced work on such top-priority projects as intercontinental and intermediate-range ballistic missiles, supersonic and hypersonic aircraft, and airplanes powered by nuclear energy.

Today we are talking seriously about bombers and fighter type aircraft that will travel at four times the speed of sound. They would cruise at a height of more than 50,000 feet for as many as 200 hours and have new types of propulsion. Under such conditions, atmospheric friction alone would heat the aircraft's external skin to around 800 degrees F.

In not too many years, we will probably be building planes to operate at *six* times the speed of sound—at an altitude of 35,000 feet—that is about 3700 miles an hour. Although the temperature of the atmosphere above 35,000 feet is minus 67 degrees F., planes flying at "MACH 6" for as long as fifteen minutes must be built to withstand outside skin temperatures of 3000 degrees F. To launch a satellite beyond the pull of gravity, it is predicted, an escape velocity of more than thirty times the speed of sound must be developed.

To bring such incredible performances within the realm of possibility, scientific laboratories must discover or create new materials because the substances in common use today would not



By

GENERAL JOSEPH T. McNARNEY, USAF (Ret.)

President, Convair Division
General Dynamics Corporation
San Diego, Calif.

withstand environmental temperatures that in the future may range from as low as minus 450 degrees F. to as high as 60,000 degrees F. Temperature extremes are not the only problem. Scientists of today are concerned also with the ionization and nuclear deterioration of structural materials.

Limitations in the strength of materials are not the only difficulties that must be surmounted in this coming age of fantastic speeds and staggering distances. Dimensional and metallurgical tolerances will of necessity be microscopically close.

Clearly, we must find new methods of achieving this kind of precision in parts shaped from difficult-to-handle materials like titanium, high-temperature steels, ceramics, and combinations of ceramics and metals. Machine tools and manufacturing processes must be developed for working such materials adequately.

As the technical limitations imposed upon our facilities are extended by new materials, the men responsible for designing new products will be forced to re-examine their traditional engineering concepts, in order to make maximum effective use of new substances and ideas. Projects as technically advanced as some of those mentioned are already making formidable demands upon the scientific and engineering knowledge of our most highly trained people in the fields of electronics, metallurgy, aerodynamics, thermodynamics, propulsion, and human factors. Scores of projects that were beyond our wildest dreams fifty years ago no longer seem impossible to attain and are being pressed with all possible urgency today.

General Joseph T. McNarney, USAF (Ret.), president of the Convair Division of General Dynamics Corporation, joined the Consolidated Vultee Aircraft Corporation when he was elected president of that company on March 3, 1952, after more than thirty-six years in the service, including combat duty in World Wars I and II. On April 30, 1954, the effective date of the merger of Consolidated Vultee into the General Dynamics Corporation, General McNarney was appointed president of the Convair Division and was also elected a senior vice-president and director of General Dynamics. After World War I, General McNarney assumed command of Air Force bases, attended the Command and General Staff School, and became an Army War College instructor. In September 1945, he became acting supreme allied commander in the Mediterranean Theater of Operations, and the following December succeeded General Eisenhower as commanding general of the United States Forces in the European Theater and commander-in-chief of the United States Forces of Occupation in Germany. Among other important assignments after returning to the United States, he was commanding general of Air Materiel Command at Wright-Patterson Air Force Base, Ohio, from October 1, 1947, to September 1, 1949.

THE PLANT BEHIND A FAMOUS POWER PLANT

By EDGAR ALTHOLZ
Associate Editor

At North Haven, Conn., United Aircraft Corporation's Pratt & Whitney Aircraft Division has concentrated machining activities for its jet engines.

CONTINUING heavy military and commercial demands for jet aircraft require the engine manufacturer to preserve his traditional role in the vanguard of machine tool technology. Engineering changes in parts and materials—vital to air superiority—frequently are contingent on the development of suitable machine tools or machining techniques. More often than not, this development is a joint effort of the machine tool builder and the aircraft engine plant. At the big Pratt & Whitney Aircraft installation at North Haven, Conn., there are many unusual examples along the production lines of this collaboration between the machine tool builder and the machine tool user.

This plant, a modern structure, has recently been enlarged and now contains 1,000,000 square feet of manufacturing space. Originally, the company's piston-engine work was centered here, but

today, better than 75 per cent of the space is devoted to machining operations on parts for J-57 and J-75 jet engines.

In Fig. 1, the hub of a front compressor rotor is being finish-turned. The work surface is a conical web in the form of a deep annular recess, all of which is reached by one single-point tool. Equipment consists of a 32-inch Axelson cross-center lathe having a Voss-Raytheon electronic tracing unit mounted as a compound on the cross-slide. Two templates are fixed on the carriage saddle, each representing one-half of the conical shape.

To machine the inner half of the cone, the lathe operates in a conventional manner, with the tracer stylus guided against the front template, as is being done in the illustration. Then, to machine the outer half, the spindle rotation is reversed, and the carriage momentarily retracted while the cross-slide is run to the rear. With the carriage again advanced, the stylus now operates against the back template.

As the cross-slide feeds over the saddle, the stylus directs a sensing head to signal a control panel to advance, retard, or reverse the tracer motor. This motor drives the screw of the compound rest. The lathe itself is powered by a 30-hp, constant-torque, direct-current motor through a Reliance variable-speed drive. By means of a cam on the cross-slide, a rheostat raises or lowers the speed of a generator set, and thus varies the spindle speed to maintain a preset cutting speed as the tool approaches or moves away from the lathe center.

Shuttles Locate Airfoils for Initial Machining

Blades and vanes are high-production, precision items for the jet-engine plant. Each stage of the engine requires its own blade and vane design. They are of various materials—stainless steel, Stellite, or titanium—and originate as castings or forgings. End areas, called buttresses, require exacting machining to permit proper assembly in the shrouds. Because of the precise curved configuration of the airfoil, a special holding means is required.

This consists of supporting the airfoil in a small open-end iron box, or shuttle, which has locating pads machined on all outside corners. To position the blade or vane correctly in the shuttle, a special duo-lens optical comparator is used; then a low-melting point alloy (Cerrobend) is poured around the airfoil section, and on solidifying secures the part. Initial machining of the buttresses is done with the part in the shuttle. Later, the shuttle is immersed in hot water to melt the alloy. The work is then held in various fixtures for finishing operations.

An initial operation on the vanes is shown in Fig. 2. Here, concave and convex surfaces and leading and trailing edges of the large (outer) buttress undergo stock removal by broaching. The equipment is one of a battery of seven Colonial 15-ton, horizontal surface broaching machines. There are two rows of broach-holders carried on the machine ram.

On the operator's left is the work-fixture slide,

Fig. 1. One template controls the tool when in front of the spindle; another, when in back. Spindle rotation is reversed as the tool crosses the center of the lathe.

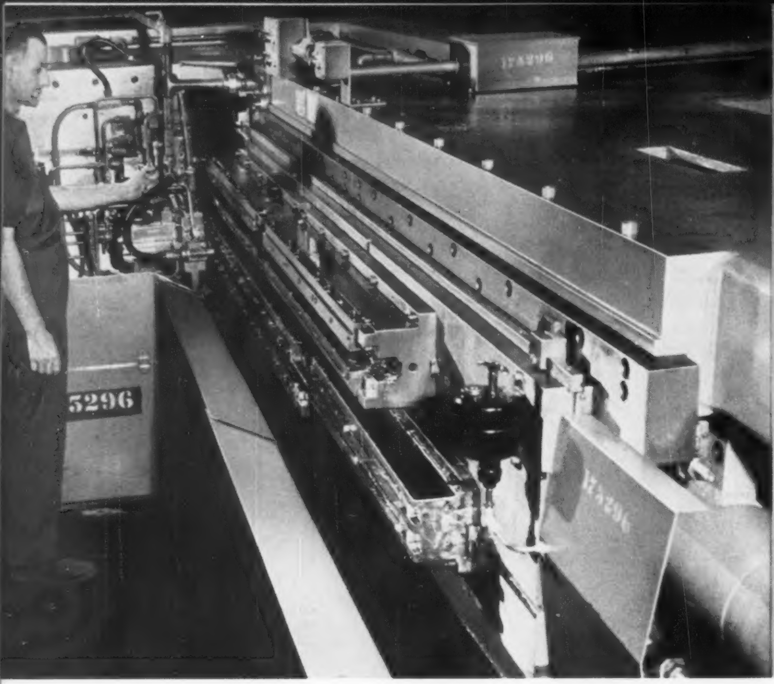


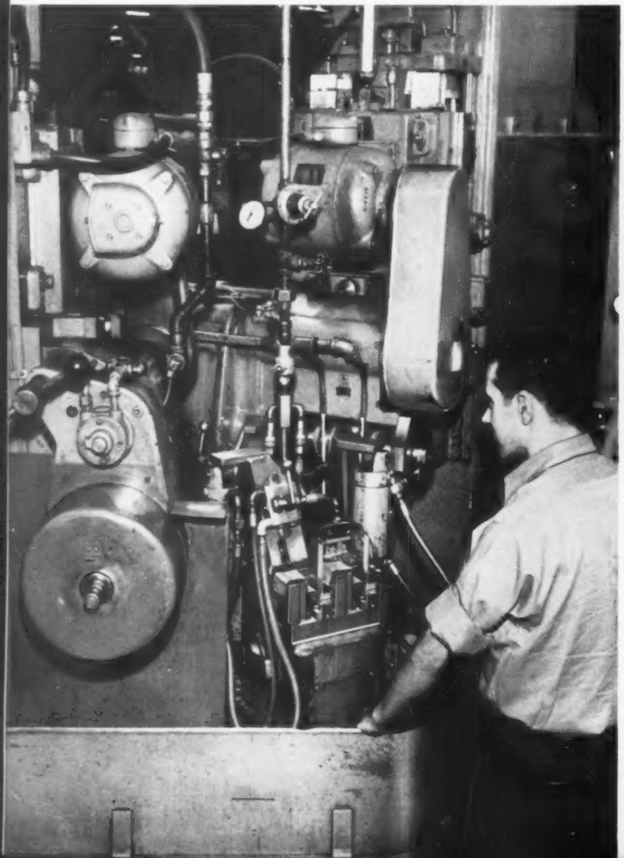
Fig. 2. (Left) In the first work position, the vane is in line with the upper broach-holder row. Meanwhile, another vane, shifted 90 degrees, is in the second work position, in line with the lower broach-holder row.

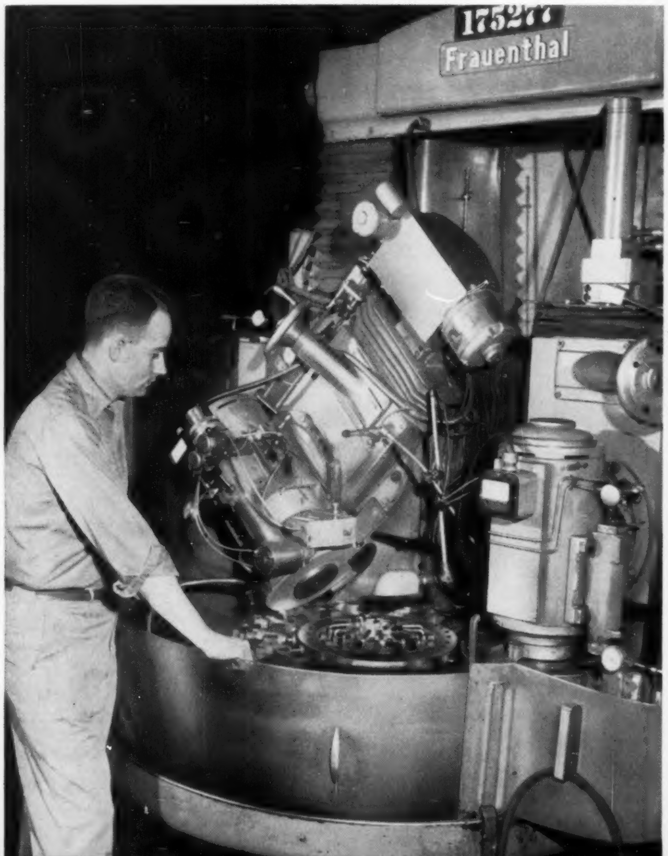
Fig. 3. (Below, left) In each milling cycle, two vanes are loaded at one station, semi-finished at the second, and finished at the third.

Fig. 4. (Below, right) Inner surfaces of the vanes are ground radially by the 45-degree head; outer surfaces, by the perpendicular head.

at right angles to the movement of the ram. Two shuttles are handled simultaneously, one in line with the upper broach-holder row, and the other, with the lower row. In successive cycles of the machine, the shuttle in the top position on the work-fixture slide is shifted 90 degrees and installed in the bottom position, and a new shuttle is installed in the vacated top position.

Broaches in the upper row cut the buttress to width, and those in the lower row generate the special profile. Shuttles are clamped automatically, and the work-fixture slide advances toward the ram until the buttresses of the vanes intersect the paths of the broaches. Movements of the fixture slide and broach ram are synchronized: When the slide is forward, the ram executes its broaching stroke, the slide then retracts, and the ram returns to its starting position.





Vanes Climb-Milled on Dial Type Machine

The leading edge of the vane outer buttress is machined on a Snyder three-station vertical mill, Fig. 3. Two vanes are handled at a time. One station is for loading, one for semifinishing, and one for finishing. At each of the two work stations, a vertical head supports four gang cutters which straddle the work.

Vanes are held in air-clamped fixtures, spaced around a horizontal table. Indexing—120 degrees each cycle—is automatic. The heads are fed down pneumatically, and the cutters climb-mill the surfaces.

Since broaching produces a buttress profile which is in a straight line, it is necessary to finish inner and outer surfaces of the leading and trailing edges so that they are radial. The operation is performed on Frauenthal double-head grinding machines. One of them appears in Fig. 4.

Twenty-two to twenty-eight vanes (now removed from their shuttles) are located around a circular fixture on the work-table. The left-hand spindle, at an angle of 45 degrees, grinds the inner surface, and the right-hand spindle, at 90 degrees, the outer surface. Both spindles operate simultaneously, grinding to a spark-out. For unloading and reloading, the spindles retract vertically.

The illustrated machine is one of a battery which grind the trailing edge buttress of the vanes. A second battery of these machines grind the leading edge buttress in a similar setup.

Form Grinding Centered Around "Ferris Wheel" Fixture

An entirely new approach to vane processing—finish-grinding all eighteen surfaces of the buttress directly from the "rough" after qualifying surfaces are established in the shuttle—is already producing remarkable savings in time and material. Developed by P & W A's production engineering department, the method consists of grouping eighteen vanes on a "Ferris wheel" fixture which revolves between three form-grinding heads. One wheel completes the vane periphery; the second, the leading edge buttress; and the third, the trailing edge buttress. The grinders operate in unison and finish all surfaces of all vanes in a twelve-minute cycle.

In Fig. 5 is a view of the fixture being loaded, and in Fig. 6, a view of the equipment (con-

Fig. 5. Loading the "Ferris wheel" fixture for the form grinders. A second, identical fixture is in work, so that production is continuous.

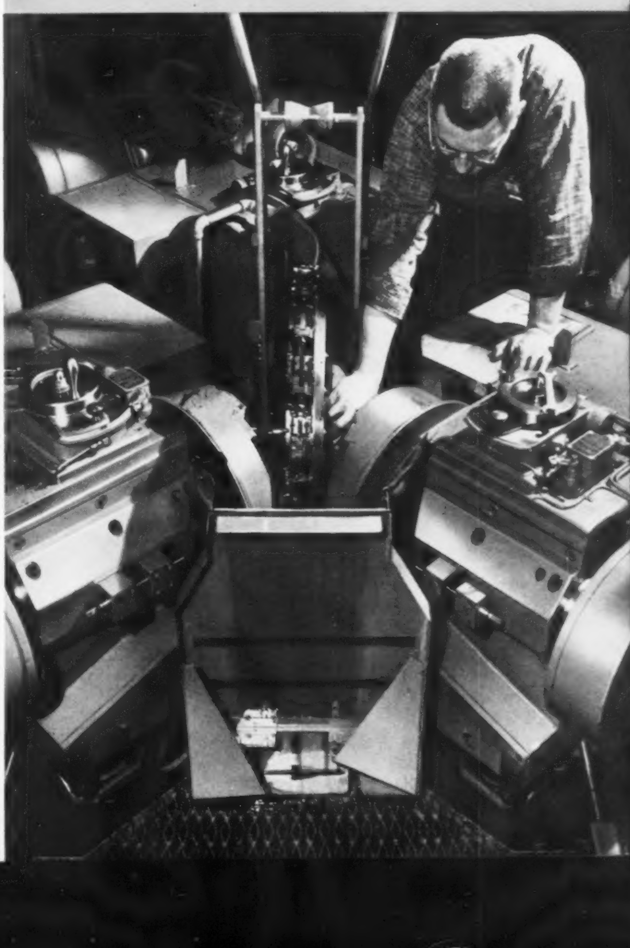


Fig. 6. As the fixture revolves on its trunnions, the three grinding wheels complete a total of eighteen surfaces of eighteen vanes.

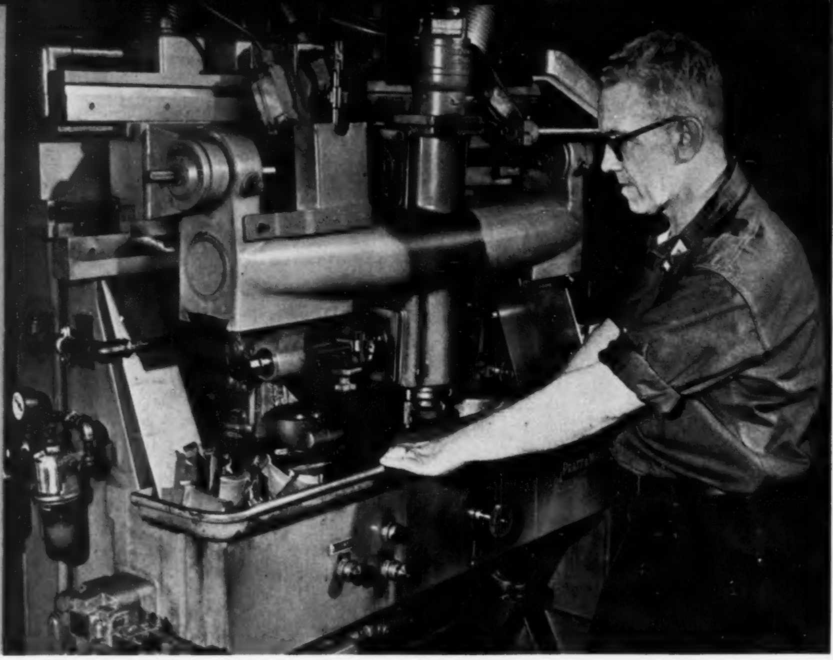


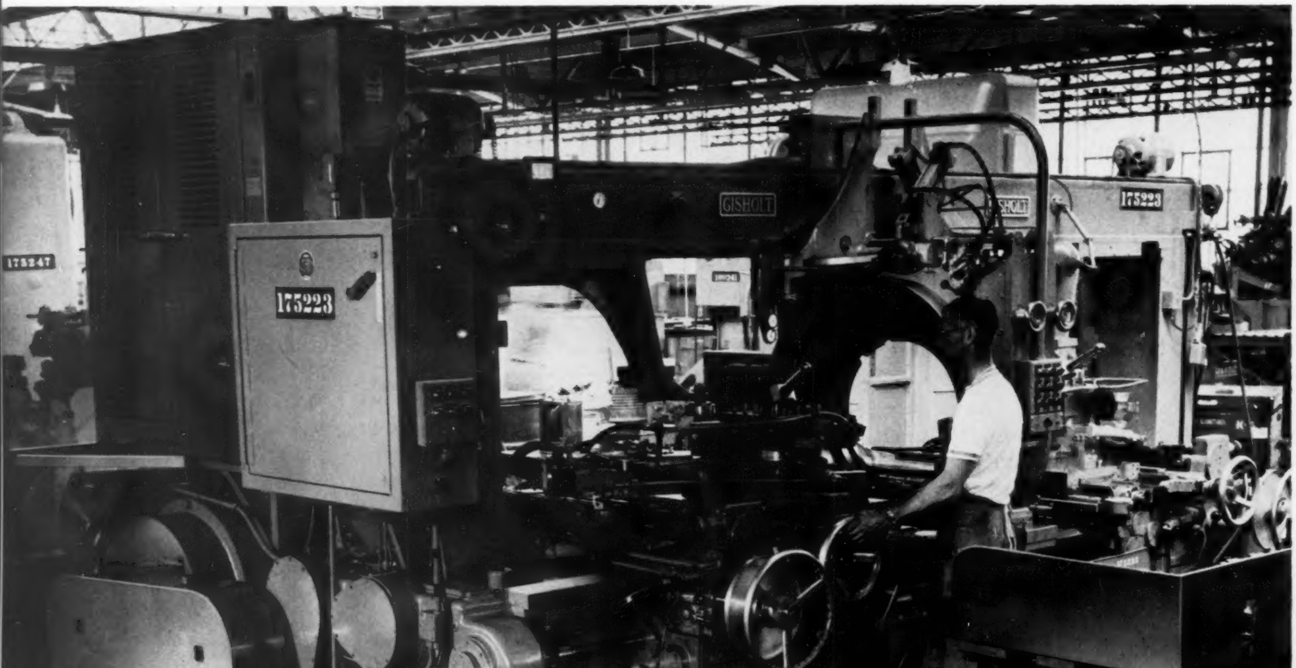
Fig. 7. (Right) The work-fixture carrier pivots toward or away from the belt, maintaining a continuous contact with the curved airfoil.

Fig. 8. (Below) Designed expressly for facing the compressor discs of a jet engine, the center-drive lathe rotates the work between two conventional carriages.

structed by Ex-Cell-O) with the fixture in position for grinding. Actually, there are two fixtures, one being unloaded and reloaded while the other is in operation. One side of the fixture, not visible, carries a face gear. When in operation, the fixture revolves on integral trunnions and is driven from a separate power source by a pinion which engages the face gear.

Before being loaded, vanes are prepared with a center hole in the small buttress and a locating point along the trailing edge side of the buttress. Fixture stations have a center which enters the hole and secures the vane by thrusting it outward. There is an overhead track by which the fixtures are transferred to the grinders from the loading rig.

Each grinding head is a self-contained unit, having its own spindle drive, wheel-slide, and diamond truing device. Wheels cut on their periphery and are automatically compensated for wear. Grinding is performed to a time cycle, and accuracy is held within 0.001 inch. With all surfaces finished together, out-of-tolerance rejects have been virtually eliminated.



Pivoting Carrier Keeps Airfoil Against Belt

The final curvature of the vane shroud end, not yet machined, is produced by stropping on a Pratt & Whitney airfoil grinder. In Fig. 7, second-stage nickel-alloy vanes are being stropped. Held in a horizontal position, the vane revolves slowly against a 50-grit belt running at 1800 surface feet per minute. To keep the airfoil in contact with the belt, the work-holding fixture is supported from a carrier which is free to pivot from front to rear. A profile cam, also suspended from the carrier, revolves with the work and causes the carrier to pivot forward or backward.

The work is located on its outer buttress, with a tailstock center supporting the inner buttress. A hydraulic motor which is an integral part of the carrier drives the work. Approximately 0.015 to 0.020 inch of stock is removed by the stropping, and a surface finish of 40 to 60 micro-inches is obtained.

Lathes Face Both Sides of Discs Simultaneously

Compressor discs are steel forgings, thin in section and large in diameter. Contours on both sides, as well as bore and periphery, require machining. To eliminate "dishing" and to balance cutting pressures, both sides are cut simultaneously on a battery of twenty-nine P & W A-designed Gisholt center-drive lathes. Another advantage is that the time for machining the sides is halved.

One of the lathes appears in Fig. 8. A large hollow bearing in the center of the machine accommodates the work. There are two conventional lathe carriages on opposite sides of the bearing, each with a cross-slide, square turret, and hydraulic tracer unit. A shaft in the base transmits the drive to the bearing.

The heading illustration is a close-up view of one side of the bearing, showing a 25-inch disc in position. Preparatory operations on a vertical turret lathe consist of taking a qualifying cut, turning the outside diameter, and grooving and facing a clamping surface. In the center-drive lathe, one of the first steps is to take a light facing cut on each side, to secure a true surface for a roller (seen prominently in the illustration) which serves as a steadyrest.

After the disc is bored out from one turret, contour-facing cuts are taken in unison from both

Fig. 9. Two templates and two cutters permit the return stroke as well as the forward stroke of the carriage to be used for machining.

Fig. 10. Throw-away inserts are standard for most single-point machining operations. A variety of inserts and tool-holders used appear here.

turrets. To maintain a constant cutting speed, carrier rotation originates from a variable-speed drive. A cam on one of the cross-slides speeds up the motor generator as the facing cutters approach center.

Tracer Lathe Feeds in Two Directions

Because of an intricate internal configuration, rear compressor drive turbine shafts are bored on a New Britain G F copying lathe. Parts of the contour are back faces and back chamfers, inaccessible to the usual tooling practice for the machine. To do the job, the machine (Fig. 9) is equipped with two templates and a two-cutter boring-bar.

In a preliminary operation, a clearance hole is bored for the bar. Then, as the bar advances toward the headstock, one of the cutters, guided by its respective template, machines the bore diameters and all walls and chamfers it can reach normally. When the bar has reached the end of its forward travel, its axis is shifted slightly, bringing the second cutter (diametrically opposite the first cutter) into operating position. At the same time, the second template is interchanged with the first one, and the back faces and back chamfers of the shaft are machined as the bar feeds away from the headstock. For the next piece, the bar axis is again shifted and the first template is used.

Cutters used in this tracer operation are throw-away carbide inserts. This type of cutter has found wide acceptance at P & W A during the last two years. Today, virtually all single-point carbides are throw-aways. Certain advantages are claimed for their use: Inserts have a low initial cost; it takes little more than a minute to index an insert when an edge has worn; the new edge generally will repeat within plus or minus 0.003 inch of the worn one, requiring a minimum of correction to a template or dial clip; grinding is dispensed with; and an inventory of the inserts requires very little physical space.

Some of the inserts and tool-holders used at the plant are illustrated in Fig. 10. The tool-holders were developed jointly with the carbide manufacturers and are designed to support the

Fig. 11. "Casket" formed by hood dampens area noise while honing. Unable to see work, operator recognizes end of cycle by sound of honing tool.

Fig. 12. More than a thing of beauty, the mirror-like surface produced will prevent service failure from cracks set up by tool marks.

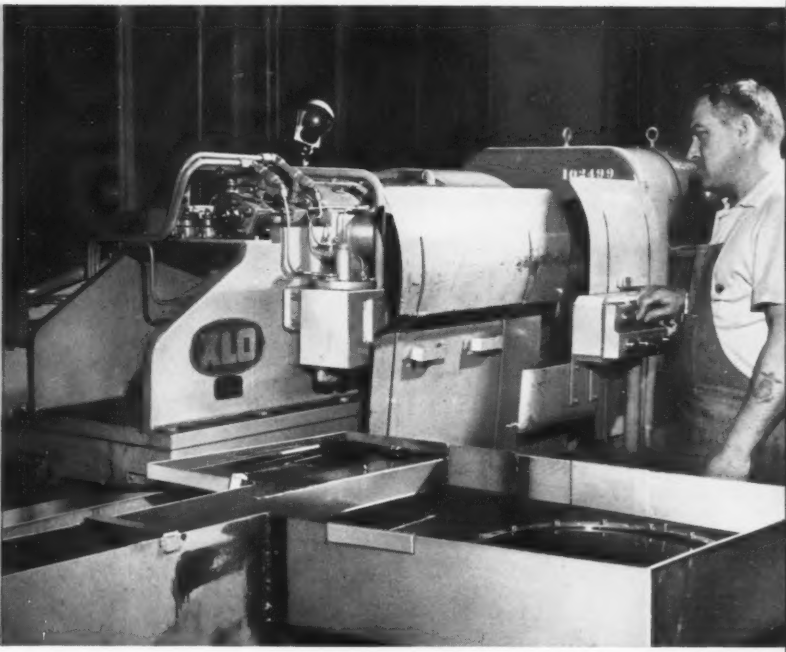


Fig. 13. Warming the ring in a tank to the operating temperature of the spindle stabilizes its geometry.

inserts at proper side-rake and back-rake angles—positive for titanium, negative for steel. Inserts for the negative-rake holders have a double life, having cutting edges available on the bottom as well as the top. Tool-holders for deep grooving, like the one at the left in the foreground, have a coolant connection directly in the shank which forces the coolant out under the insert.

Honing Machine Hood Dampens Vibrations

To avoid service failure of the jet engine from fatigue cracking, rigid "specs" have been set up for the surface finish of many critical parts. One of these is the front compressor drive turbine shaft, made from a molybdenum-steel hollow forging. Final operation consists of honing the large bore on a Micromatic machine, Fig. 11.

The work surface is 3 1/2 inches in diameter and approximately 4 feet long. It is held in a universal fixture (there being two other sizes of these shafts also in production) and the hone both reciprocates and rotates. About 0.010 inch of stock is removed by honing.

During the operation, a hood is lowered over the bed to isolate the high-frequency honing vibrations from the grinding machines in the immediate shop area. The lining of the hood is composed of sponge rubber. Coolant flows over the umbrella type honing tool and through a filtering and refrigerating unit.

Tool marks, always a possible source of metal fracture, are removed from the faces of compressor hubs on a polishing jack, Fig. 12. The operator uses a small air motor to drive a rag wheel coated with 240 grit abrasive. The wheel is directed against the work as the hub revolves on the stand.

Work Warmed in Cutting Oil

Stainless-steel disc spacer rings require a circle of sixteen holes, accurate in location within 0.0005 inch. These rings are gun-drilled on an Ex-Cell-O boring machine, two holes at a time, with eight indexes of the work. The operation is illustrated in Fig. 13.

Part of one of the rings is visible in the tank attached to the front of the machine. This tank contains cutting oil which circulates continuously, being integral with the coolant system of the machine tool. While one ring is in work, the next ring is put in the tank, where it is warmed by the cutting oil. In this way, no change occurs in the geometry of the ring during the gun-drilling, and the close tolerance on hole location is preserved.

Complementing the manufacturing activities is a machine repair program involving the services of a score of men. Each is a specialist on some particular kind of machine tool. The majority have received formal training in their jobs, both at North Haven and at the plants of the machine tool builders. Minor repairs and maintenance take place during any of the plant's three shifts. For major repairs or required modifications, a machine will be removed from the line and brought to a designated area.

SUB-ZERO quenching and the use of sub-zero coolants in machining operations on aluminum, alloy-steel, titanium, and phenolic parts have resulted in remarkable savings in the manufacturing departments of the El Segundo Division, Douglas Aircraft Co., and at the same time, have considerably improved work finishes. There are three variations of sub-zero treatment followed in this plant. First, there is a dip process that is applied after the heat-treatment of certain parts to prepare flat blanks and extrusions for forming operations. Second, sub-zero coolant is directed to the point of contact between cutters and the work in machining operations on machine tools, and the work is submerged in the bath. Third, a sub-zero and boiling water treatment is used to stabilize forgings, large bar stock, and steel or aluminum plate for the purpose of preventing distortion during machining operations.

Dipping or quenching operations on work-pieces are performed in two sequences. First, the part is immersed in a tank filled with refrigerated water which brings the blanks or parts from heat-treating temperatures down to plus 40 degrees. F. The parts remain in this tank for thirty seconds. This first step in operation facilitates maintenance of the low temperature in the sub-zero coolant which is contained in an adjoining tank into which the parts are plunged immediately after their removal from the cold water bath. The sub-zero tank is filled with ABCO—156 Solvolene, a product of the American Better Chemicals Co., Inglewood, Calif. This bath is kept at a constant temperature of minus 40 degrees F.

The mechanical equipment that maintains this constant temperature in the refrigerated water and sub-zero tanks is shown in Fig. 1. It consists essentially of a recirculating unit for the water tank and a plate type refrigerating system for the sub-zero tank.

Sub-zero quenching, by maintaining the ductility of work-pieces in the "as quenched" state, has eliminated work breakage in many forming operations. A wide variety of hard-to-form parts that previously had a high scrap factor are now formed true to size, and some parts that previously could not be formed at all are now produced with ease. On some press products, 75

Improved quality of parts made from various metals for fabrication into airframes is the important advantage gained by employing the techniques described in this article. Three variations of sub-zero treatment are followed—a dip process after heat-treatment, the supplying of coolant during machining and a sub-zero and boiling water treatment.

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MACHINING AND QUENCHING

per cent of the hand forming previously required after rubber forming has been eliminated.

The success of sub-zero quenching in forming operations led to the adoption of sub-zero coolant as a thermo-shock treatment in machining setups. Under this treatment, forgings become stabilized and can be machined without warpage or distortion to blueprint tolerances. Tool life has been substantially increased.

Parts of SAE 4130 chrome-molybdenum steel held at sub-zero temperature are sawed in one-half the former cutting time. There is no evidence of hardening on the work edges, and a considerably better finish is obtained. The soft burr produced can be removed easily by hand scraping.

Chrome-molybdenum steel heat-treated to a tensile strength of from 260,000 to 280,000 psi has been machined on an engine lathe with sub-zero coolant supplied to the cutter edges at spindle speeds and rates of feed that are impossible under normal conditions. Although the tool life in conventional operations is short and costly, repeated cuts have been taken under the new process with no measurable wear on the tool, even though finishes from 19 to 20 micro-inches have been obtained.

Numerous production runs have been made on a large milling machine on such materials as chrome-molybdenum steel, stainless steel, and titanium with unusually good results. In all cases, the parts machined were of the problem type on which cutters ordinarily have a short life and good work finish is difficult to obtain.

The heading illustration shows a milling operation in which the sub-zero coolant (ABCO–156 Solvolene) is being applied. Fig. 2 shows a general view of the same machine with the "cold equipment" in the foreground. The reservoir for the sub-zero coolant is at the right. A centrifugal pump forces the fluid through a 2-inch tube which delivers it to the gang cutters and the work, as shown. The coolant brings the cutters and the work down to a temperature of between minus 40 and minus 50 degrees F. The coolant collects on an inclined pan on the table of the machine. This pan is of aluminum and is insulated against heat from the machine table. The coolant drains from the pan by gravity back to the reservoir.

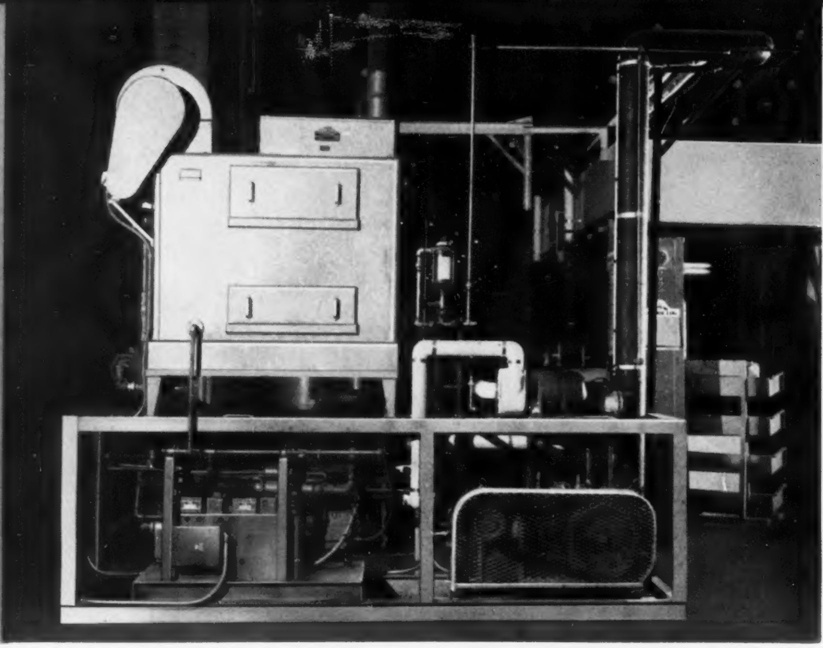


Fig. 1. Equipment which maintains a temperature of 40 degrees F. in a refrigerated water tank and supplies sub-zero coolant to a dip tank.

Fig. 2. Equipment at the rear of a horizontal milling machine supplies sub-zero coolant through a 2-inch tube to the cutters and work.

Fig. 3. Arrangement of sub-zero cooling equipment on a pantograph type machine used for a variety of duplicating operations.

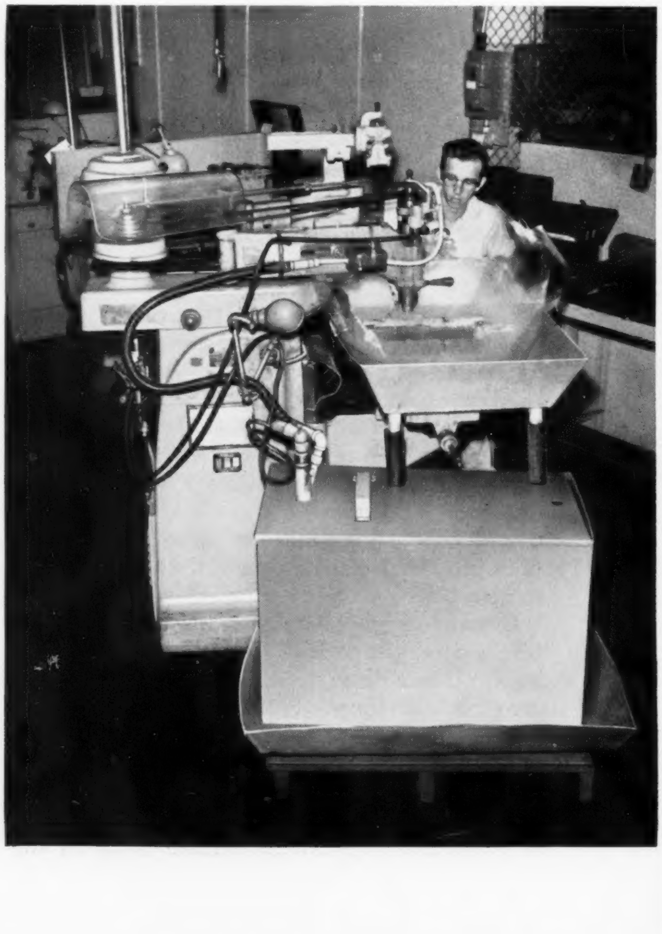
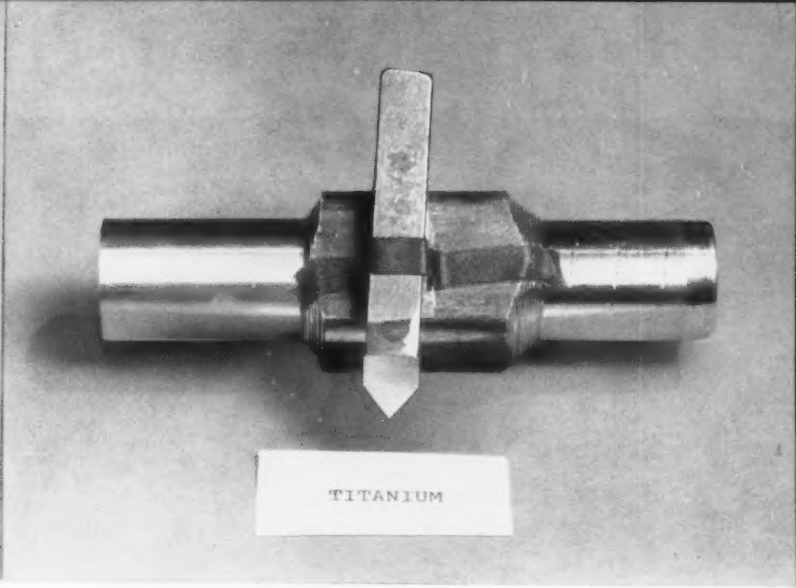


Fig. 4. The left-hand end of this titanium bar was machined during the application of sub-zero coolant; the other end, under normal machining practice.

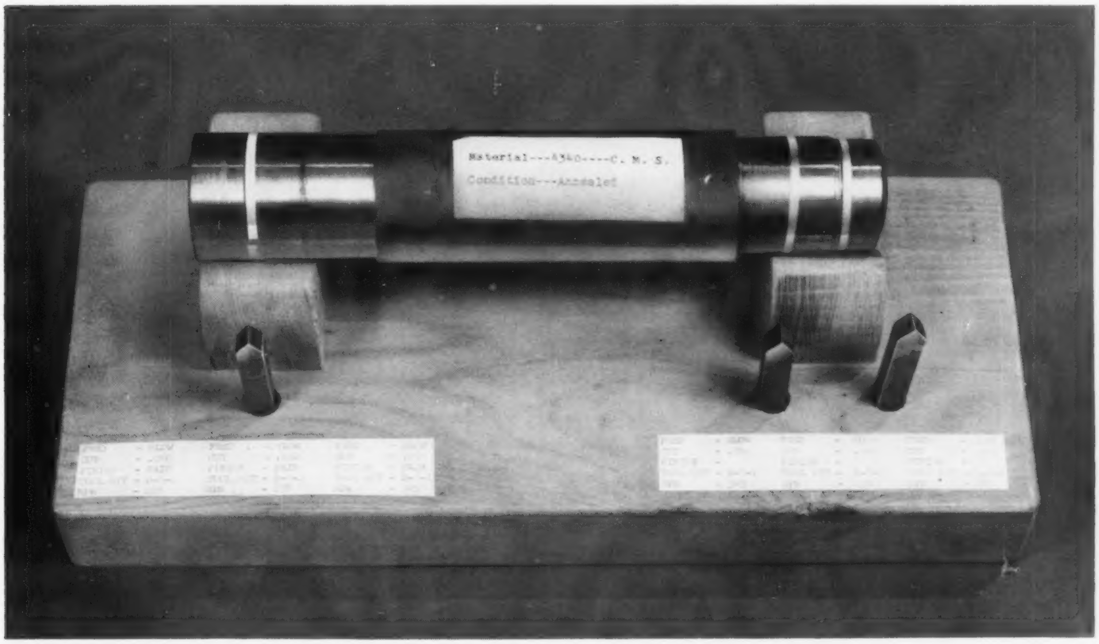


The technique in operations of this type is to immerse the work part in the reservoir from ten to fifteen minutes, depending upon the cross-section of the part, before placing it on the machine fixture. This chills the part prior to machining.

Another sub-zero machining operation is illustrated in Fig. 3, which shows a Gorton pantograph type machine that is used for a variety of duplicating operations. In these operations, the use of sub-zero coolant has been successful far in excess of expectations. Cutter life at the high speeds used has been almost unbelievable. On chrome-molybdenum steel, stainless steel, and titanium there has been no appreciable cutter wear, and the work finish is of high quality.

The type of finish obtained on a titanium bar when the sub-zero process is employed can be compared with the finish formerly obtained on the same part by referring to Fig. 4. At the left is seen the surface obtained under conditions of sub-zero cooling, while at the right is a finish normally obtained under conventional machining practice. The cutter used in this work is seen

Fig. 5. Chrome-molybdenum steel bar of which the left-hand end was machined under conventional practice and the right-hand end with sub-zero coolant supplied to the cutters and work.



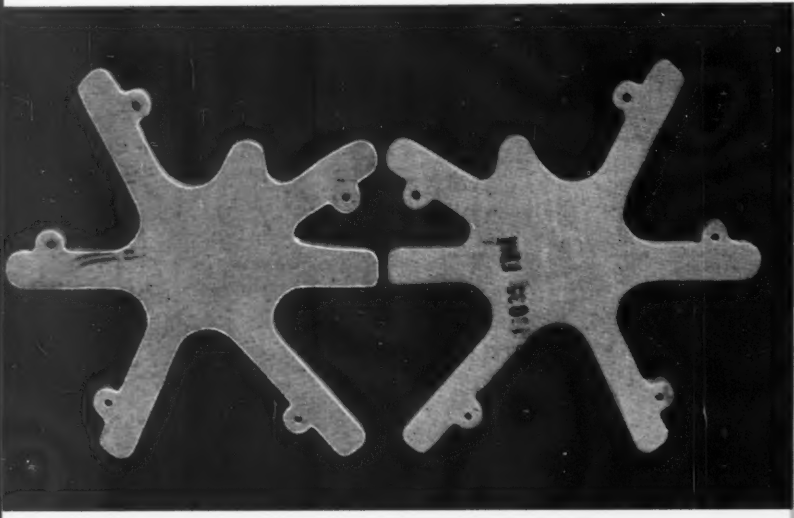


Fig. 6. Two phenolic parts 1/2 inch thick, the left-hand example having been routed under conventional practice and the right-hand example with sub-zero coolant supplied to the work and routing tool.

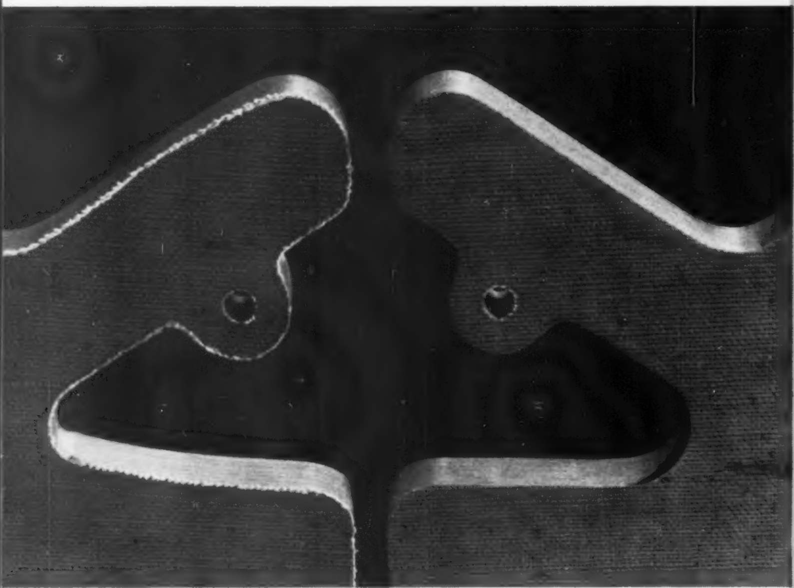


Fig. 7. Close-up view of the parts in Fig. 6, showing the ragged edges obtained with conventional routing and the clean edges that are achieved with sub-zero machining.

Fig. 8. To stabilize parts, they are immersed first in a cold bath and then in a hot bath. The equipment that is used in this combined sub-zero quenching and boiling water quenching is here shown.

attached to the work-piece. In Fig. 5 is an example of a chrome-molybdenum shaft on which the left-hand end was turned under conditions of normal practice, and the right-hand end with the cutters and work supplied with sub-zero coolant. It should be noted that the highest finish on the right-hand end was obtained with a work speed of 278 rpm. The depth of cut in all cases was 0.060 inch.

The favorable results obtained by providing sub-zero coolant in routing operations on phenolic sheets is strikingly apparent in Figs. 6 and 7. At the left in Fig. 7 may be readily observed the ragged edges obtained on the phenolic sheets when normal routing practice is followed. At the right may be seen the clean edges obtained when sub-zero coolant is supplied to the routing cutter and the work. Obviously, the hand finishing of the fabric edge that was formerly necessary has been completely eliminated as a result of the clean cut achieved. Moreover, the cutter life has been extended from two parts between grinds to seventy-five parts of this highly abrasive material. On work of this type, the cutter runs at 22,000 rpm. The phenolic sheet is 1/2 inch thick.

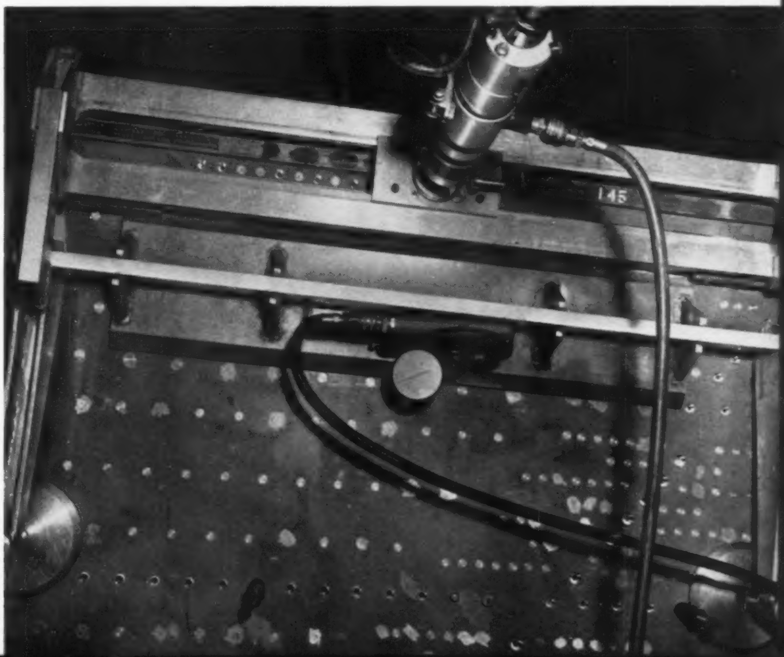
The successive sub-zero and boiling water quenches in the third treatment previously referred to are used primarily on forgings and bar stock that were formerly either impossible to form or could be machined only with excessive tooling costs. The parts are previously heat-treated in some instances and in others they are in the T6 condition when they come to the quenching facility. By immersing the part first in the cold bath, which has a temperature of minus 100 degrees F., and then in a hot bath of 212 degrees F., the part can be stabilized to the point where machining distortion is minimized or eliminated. Fig. 8 shows the equipment used for this cycle of operations.

Suction Holds Rivet-Hole Jig to Aircraft Skin

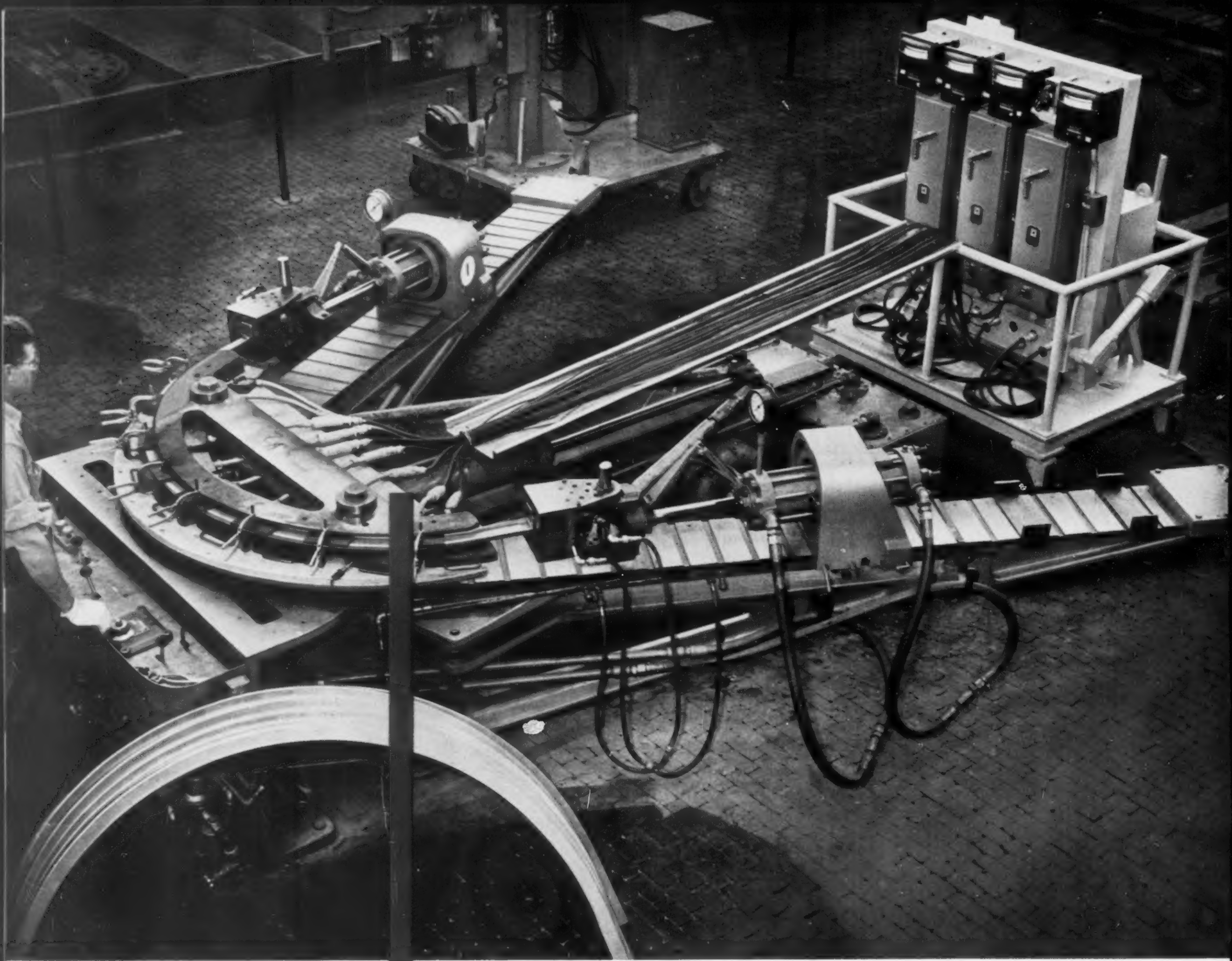
In building the Navy's P6M SeaMaster, the Martin Co., Baltimore, Md., has to drill and countersink thousands of rivet holes in the skins. To do the job accurately and economically, the company uses a Keller Airfeedrill in conjunction with a vacuum jig it developed.

There are three components of the jig—a vacuum plate, a slide assembly for holding the drill, and a clamp at each end of the slide assembly. A venturi, operating off shop air, draws the vacuum which holds the plate to the panel.

The jig rests on a pair of tracks attached to the skin. Notches along the lower track serve as locators for the drill. When the drill is in correct position, a lever enters the notch. After drilling and countersinking a hole, the lever is raised, and the drill moved along until the lever enters the next notch. When the last hole within the range of the slide is completed, the vacuum is released, and the jig is moved to a new location. Pressure on the assembly is increased by tightening the two clamps.



Front view of skin in which rivet holes are being drilled and countersunk. Jig is held against skin by vacuum pressure as drill progressively produces the holes from one end of the slide to the other.



HEAT— THE KEY TO FORMING TITANIUM

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Unlike mild steel and aluminum, which can be formed at room temperature, titanium requires controlled application of heat to prevent distortion and in-process failure. How, then, is this heat to be applied at the right time and at the right place? In stretch-forming, universal heating blocks do the job—in drop-hammer work, the titanium blank serves as a heating element.

INTRICATE contours and small-radius bends can be formed in titanium details without fear of distortion or material fracture. Such operations are a routine part of a day's work at Martin. The key to the process is the controlled usage of heat, ranging in temperature from 300 to 1400 degrees F. depending on the final shape of the work and the forming method employed.

Two basic methods of heating are being pursued. One makes use of individual heating blocks to elevate the temperature of the work a few hundred degrees. In the second method, the work itself serves as a resistance heating element and is raised in temperature to a red heat. The titanium parts shown in Fig. 1 are typical of those produced by both hot stretch-wrap forming and resistance-heated drop-hammer forming.

Details are Stretched Against Heated Form-Blocks

Heated form-blocks are a requisite for the successful stretch-forming of titanium-alloy parts. However, between fifty and one hundred of these blocks must be designed, constructed, and stored for the production of only one aircraft, for example the P6M SeaMaster, a 600-mile-per-hour seaplane powered by four turbojet engines. Providing a built-in heating arrangement for each form-block would cause tooling costs to pyramid.

The answer was found in the development of individual electrical heating units that are universal in their application to virtually any form-block. Four of these flat heating units are shown on a work-bench, together with one quick-disconnect cable, in Fig. 2. Because of their size and configuration, they can be arranged to conform with the shape of all form-blocks used.

In use, the heating units are attached to the under side of the form-block, as can be seen in Fig. 3. Heat is then transferred from the units into the block and from the block into the detail being formed. It is necessary, therefore, that the block be made of steel plate instead of Masonite. Large openings are cut in the steel block to keep its mass to a minimum. Several layers of asbestos board are placed beneath the heating units to retard the downward transfer of heat.

Quick-disconnect cables link each heating unit with a control panel containing a 45-kva transformer having 440-volt primary windings. The control panel is mounted on casters so that it may be transported easily from machine to machine as needed. It is shown in the heading illustration servicing a 17-ton Hufford stretch-wrap forming machine. The form-block illustrated is being heated by nine of the individual heating units. Facilities for fifteen units are provided by the control panel.

Constant temperature is maintained by the use of thermocouples. Wells are drilled and tapped in the form-blocks to accept three probe type thermocouples, while a fourth is inserted in one of the heating units. This last thermocouple can be seen in the heading illustration, extending from the second heating unit from the right-hand side of the form-block.

Four control units are mounted on the panel. Three of these are connected to the thermo-

Fig. 1. Tail pipe details that have been fabricated of titanium alloys. These are typical of parts that are being produced by hot stretch-wrap forming and by resistance-heated drop-hammer forming.

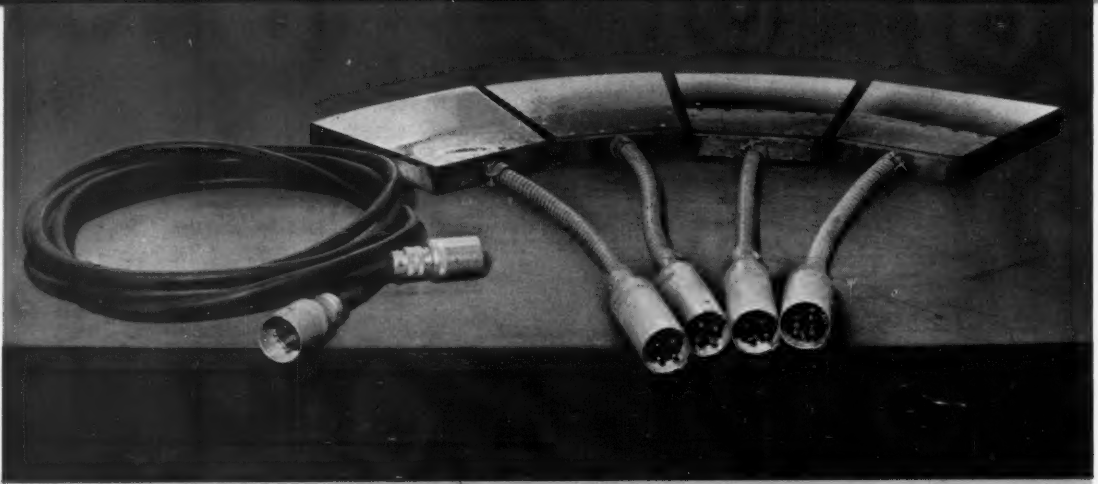


Fig. 2. Individual heating elements are used to raise the temperature of the form-block when stretch-forming titanium alloys. All the heaters are connected to a central control panel.

couples in the block to assure a uniform temperature throughout the member. The fourth controller is connected to the heating unit housing the thermocouple. This single thermocouple performs the function of an anticipator and prevents the other units from overheating.

Formability of titanium increases greatly at a comparatively small elevation in temperature. By this token, temperatures as low as 300 to 400 degrees F. have proved sufficient for the stretch-forming process.

The original part, being straight in most instances, makes initial contact with the form-block at one point only. This, then, means that only the immediate point of bend is brought to the proper heat. As the two hydraulically actuated arms pivot to the rear of the machine, the work material is wrapped around the form-block.

Sufficient time must be allowed during the wrapping operation for adequate heat transfer to take place between the block and the work at each instant of contact. Although this transfer occurs at what is considered a fast rate, the process is admittedly slowed down to approximately half the speed that would normally be used. It is important that a uniform heat be maintained along the area of bend. In view of the high tensive forces being imposed on the work, any hot spots might very likely result in localized over-stretching and possibly work failure on the machine.

Little, if any, springback is encountered even though the parts are not over-formed. Final shape is maintained by retaining the work, after completion of the cycle, at heat and under tension for a sufficient period of time to permit the

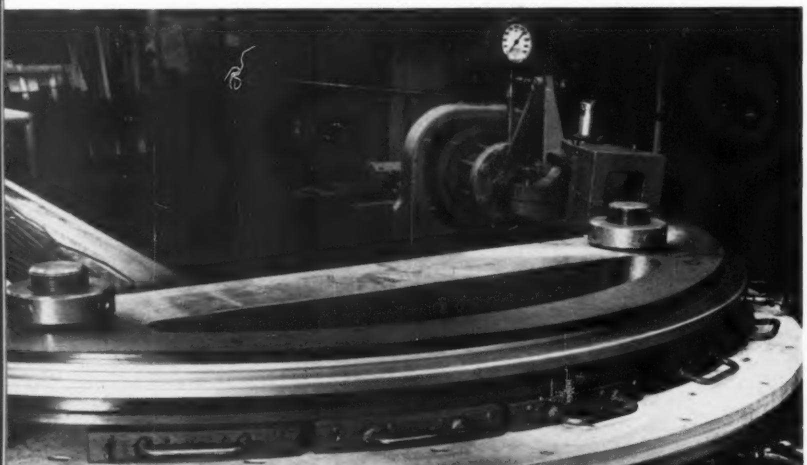


Fig. 3. A battery of heating elements has been placed beneath a steel form-block on this 17-ton stretch-wrap forming machine. Four thermocouples are used to control the temperature of the form-block.

Fig. 4. Aluminum tabs are welded to the titanium blank to serve as electrode gripping areas. By using aluminum for this purpose, it is possible to minimize the amount of titanium that will end up as scrap when the finished part is trimmed.

work to take a permanent set. All formed titanium-alloy details are required to undergo a stress-relieving operation.

Titanium Serves as Heating Element in Drop-Hammer Forming

Heat is a factor to be considered when drop-hammer forming titanium as well as when stretch-forming. There is, however, a difference in the intensity of the heat and in the method involved. Since heat transfer directly from the dies is not practical, another method of bringing the blank to the necessary temperature is required. Resistance heating of the work-piece has proved to be the answer.

Titanium, a material of high electrical resistance, is ideally suited for this type of heating. Elevated temperatures can be obtained with relatively low voltages. The developed blank is clamped to the electrode terminals and heated while suspended in the correct forming position. This method permits the realization of maximum forming temperature with a minimum loss of heat. The temperature achieved is dependent on the area and thickness of the detailed blank as well as the magnitude of the electrical power.

To achieve uniform temperatures, the developed blank must be of uniform cross-section throughout its entire area. Any deviation will result in a higher temperature in the area having the smallest cross-section. Operations that alter the cross-sectional area—such as cutouts and lightening holes—must be completed after forming. Another factor that influences the temperature of the developed blank is its shape. Blanks that are of curved configuration develop higher temperatures along the inner curved edge.

Use of resistance heating makes it necessary for the developed blank to extend in length beyond the confines of the die to enable the material to remain clamped during the forming cycle. It is apparent that an excessive amount of scrap metal is involved. To reduce the amount of expensive titanium required to a minimum,

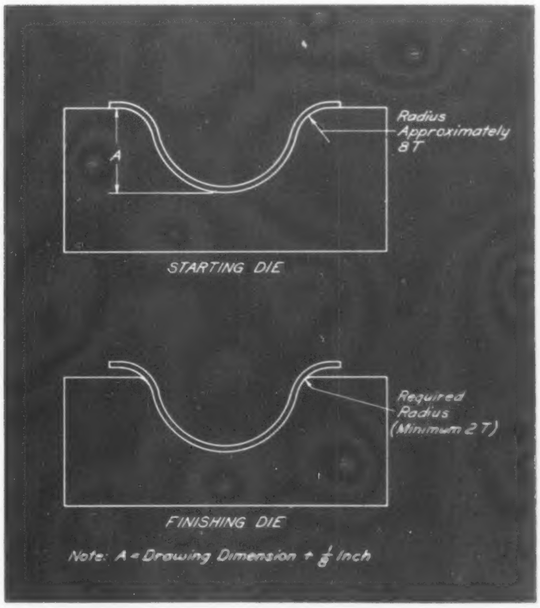


Fig. 5. Corner radii of 2T are to be formed in the blank shown in Fig. 4. To accomplish this, two dies are used—the first die bringing the radii to 8T, the second one reducing them to 2T.

Fig. 6. Duct member is shown following the initial forming strike. The aluminum tabs are firmly gripped by electrode clamps at either end of the die member.

aluminum tabs are fusion welded (using an aluminum filler rod) to each end of the blank to serve as electrode attachment areas. A secondary benefit is that the area of resistance is reduced due to the excellent conductivity of the aluminum tabs, thereby reducing the power required to achieve the desired temperature elevation. The tabs can be made of the following alloys: 1100-0, 5052-0, 6061-0; and they can vary in gage thickness from 0.032 to 0.064 inch.

In Fig. 4 can be seen a blank of A-110 AT Rem-Cru titanium that has already had two aluminum tabs welded in place. The part is to be formed into one-half of a duct for use in a high-temperature, high-pressure de-icing system. An interesting feature of this particular operation is that the flange corners must be formed to a radius of two times the material thickness. Normally, the minimum radius would be four times the material thickness.

Two dies are required to form a corner of as small a radius as this—a first operation, or starter, die and a second operation, or finishing, die. The application of these is shown diagrammatically in Fig. 5. For short runs, the drop-hammer tools are of the conventional type, that is, a Kirksite die and a stainless-steel jacketed lead punch. The die can be seen below the welded blank (mounted on a Chambersburg Cecostamp) in Fig. 4.

Shoulders and lead traps must be either omitted or modified on all dies to be used in conjunction with the resistance heating technique. Since the developed blank projects beyond the limit of the die, any shoulders that might be present will create a shearing action on the work. The aluminum tabs will be severed, thus rendering the detail useless for further heating.

When employing the resistance heating method, the die surface must be electrically insulated from the developed blank during the heating cycle to prevent a short circuit from occurring when the blank being heated contacts the drop-hammer die. Should contact be made between the two members, local overheating and pitting of the work material will result. Electric insulation is obtained by first thoroughly cleaning the surfaces to be insulated, which are the upper surfaces of the die member, then brushing on a thin film of liquid Sauereisen cement.

When the film dries, a forming lubricant is applied to the die. This consists of a thin coating of Molylube—a molybdenum disulphide powder carried in an oil vehicle.

Low voltage and high amperage are supplied by a 50-kva mobile power pack. A maximum of 40 volts is available. In the illustrated forming, a current flow of 1200 amperes at 10 volts is used.

Prior to the first strike, the blank assembly is positioned over the die member. The aluminum tabs are then secured between the jaws of the electrode clamps located at either end of the die. Current is turned on for a few seconds, just long enough to bring the titanium portion of the weldment to a temperature of 1100 degrees F. When this temperature is reached, electricity is shut off, and the first strike is made. Results of the first forming operation can be seen in Fig. 6.

For the final operation, this punch and die is replaced by the finishing punch and die. Once again the work is positioned over the die member, and the aluminum tabs are secured to the electrodes. To set the finished detail and to increase formability, the work is brought to a temperature of 1400 degrees F. for the final

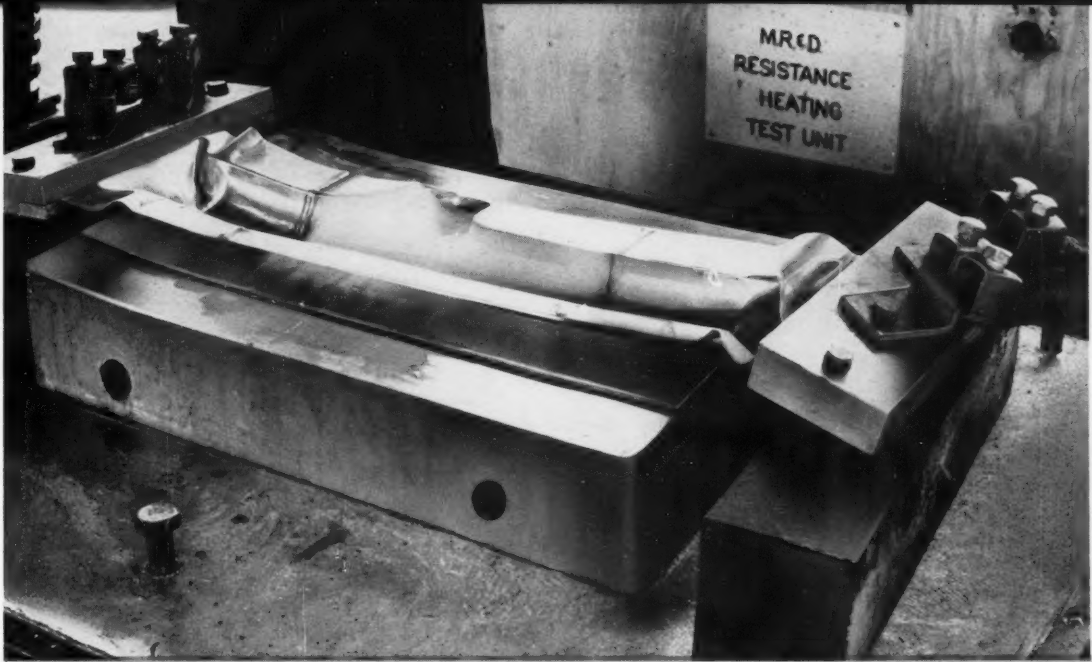


Fig. 7. Current is turned on just prior to the forming strike in the second of two dies. The titanium section is at red heat, while the aluminum tabs are cool to the touch.

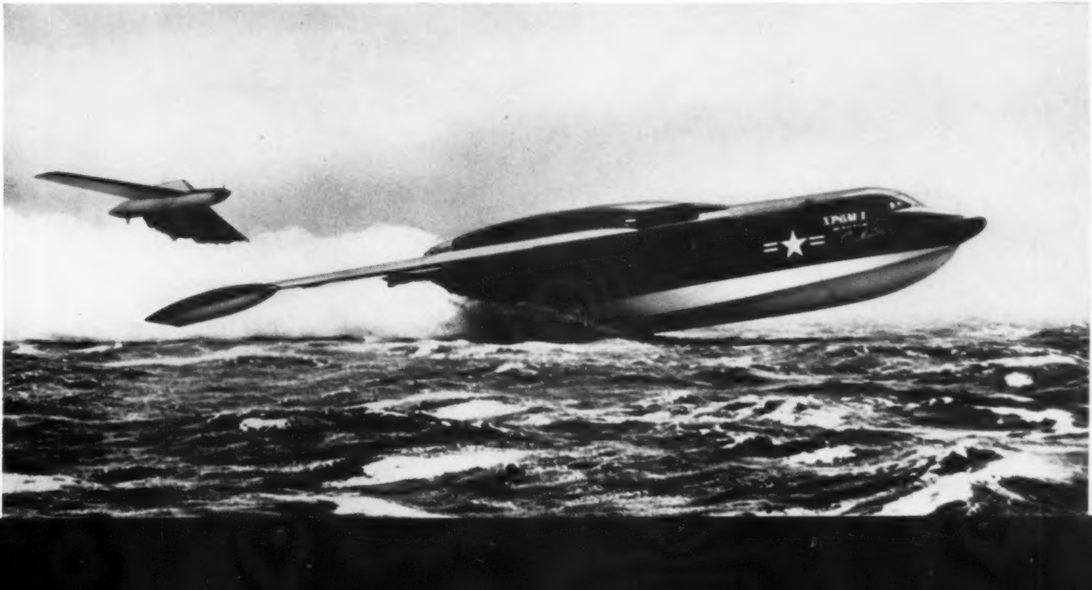
strike. Although the titanium is at a red heat, as shown in Fig. 7, the aluminum tabs are cool enough to be touched by hand. To reach a temperature of 1400 degrees F., current flow is maintained for a maximum of twenty seconds, then shut off as the punch descends.

Following this final forming step, the titanium duct section is rough-trimmed on a high-speed Tannewitz friction type band saw. After trimming, the drop-hammer details are placed in a 20 per cent nitric acid bath to insure the removal of any lead and zinc particles that may have been picked up from the die.

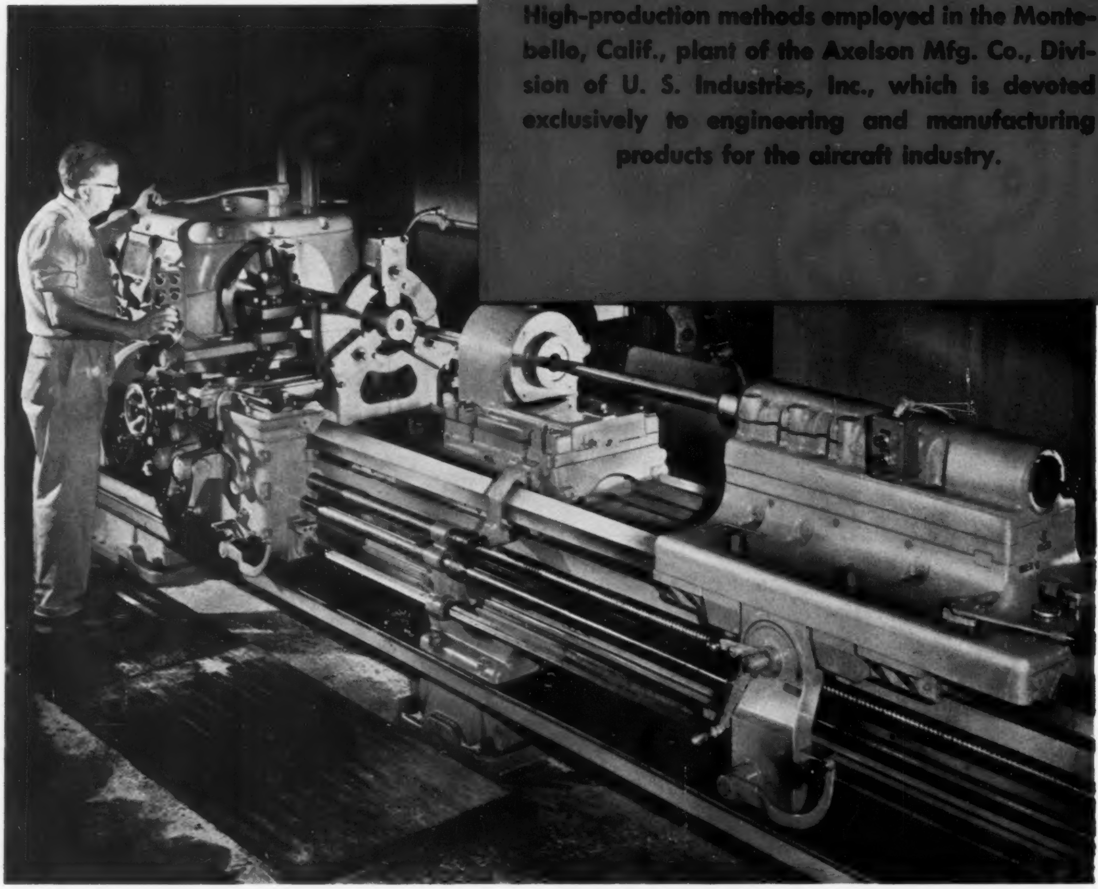
The part is then placed in a molten salt bath at a temperature of 800 degrees F. to loosen the scale that is present. Complete removal of the scale is accomplished by quick-dipping the parts in a bath consisting of 30 per cent nitric and 2 per cent hydrofluoric acid, by volume, with the remainder being water. After the two mating duct halves have been joined by welding, they are stress-relieved.

It can be said that in applications such as described, resistance heating is ideal for achieving the necessary high temperatures for forming titanium parts. It permits minimizing the total time that the material must be held at these temperatures. This is essential, as titanium becomes embrittled when subjected to elevated temperatures for prolonged periods of time. Controlled temperatures that are higher than those feasibly attained by furnace heating can thus be realized. Another important factor is that the blank is heated while in the correct forming position.

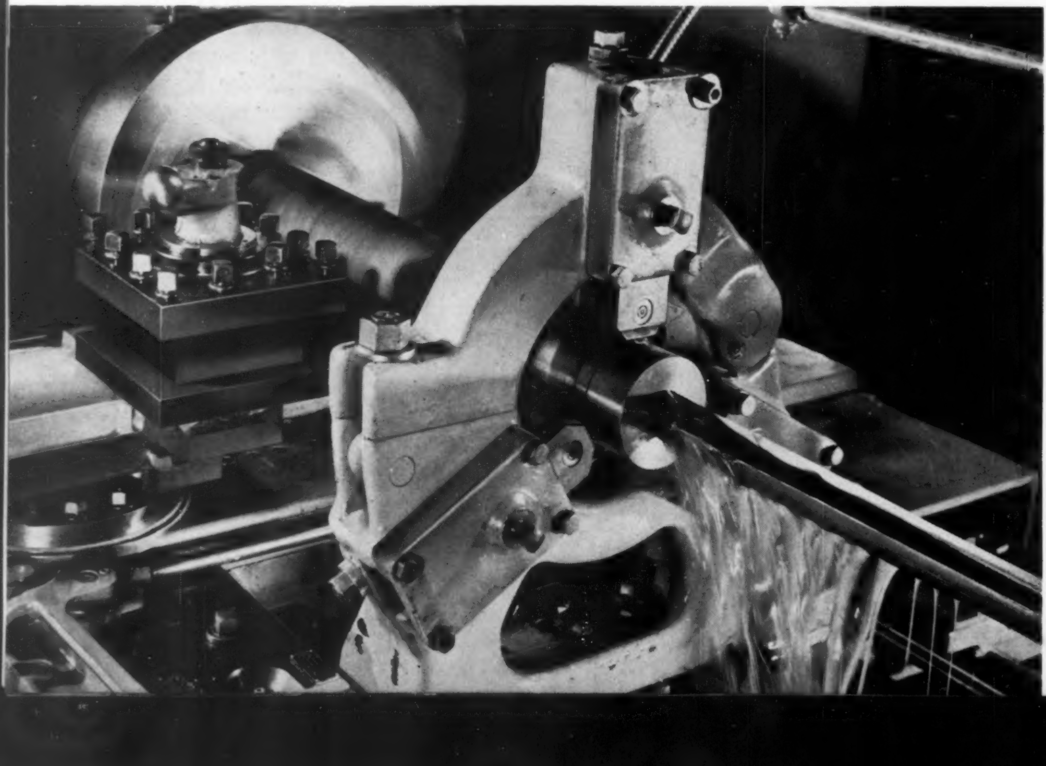
P6M Martin SeaMaster



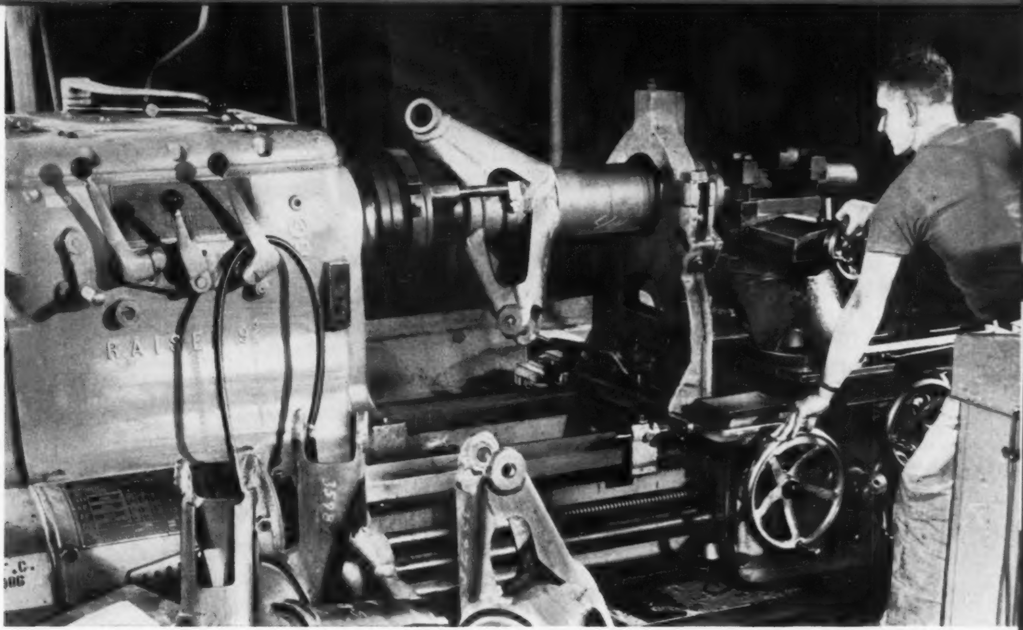
High-production methods employed in the Montebello, Calif., plant of the Axelson Mfg. Co., Division of U. S. Industries, Inc., which is devoted exclusively to engineering and manufacturing products for the aircraft industry.



Gun-drilling an aircraft landing-gear part of Hy-Tuff steel 36 inches long on an Axelson lathe. Bore size is being held to 1.730 inches. Present cutting time of 1.3 hours is a substantial improvement over the 4 to 6 hours formerly required by conventional drilling methods.

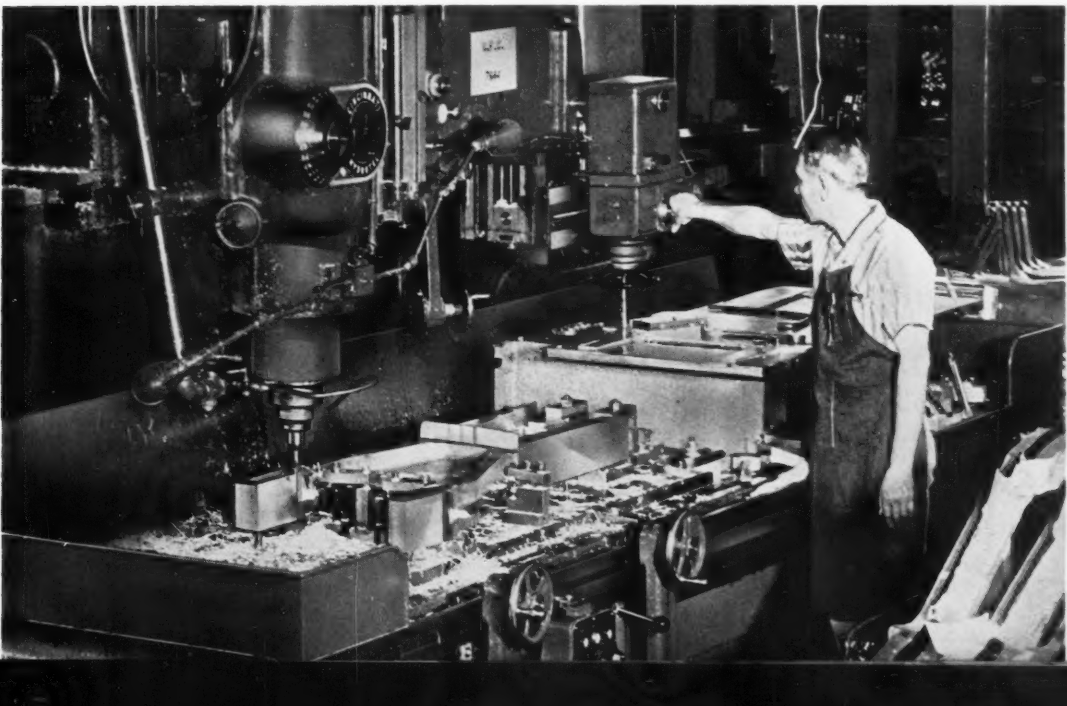


AXELSON MACHINES WIDE VARIETY OF AIRCRAFT COMPONENTS

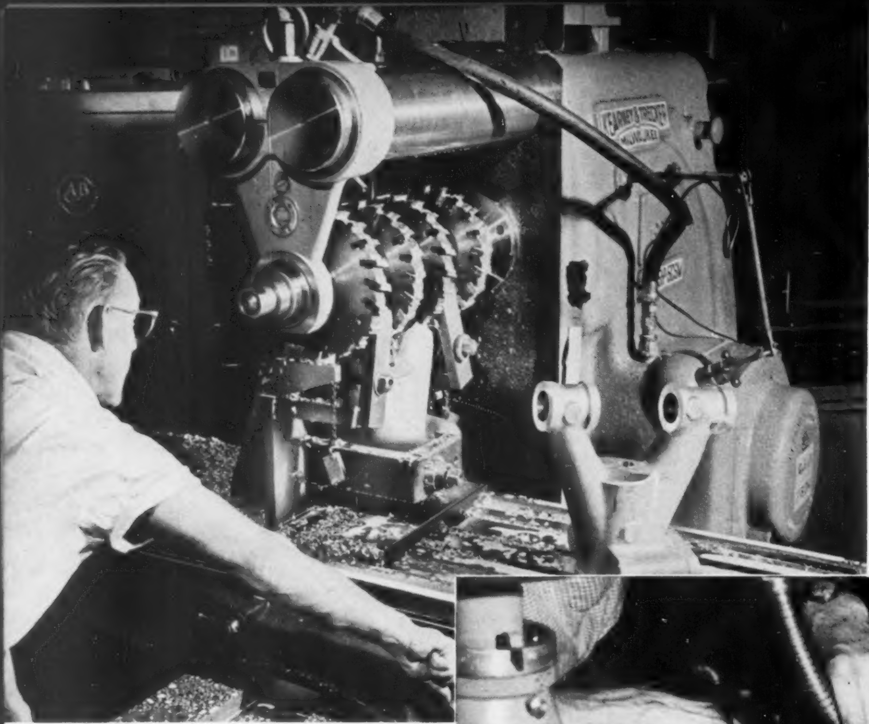


(Above) A number of aircraft components having integral extensions must be turned and bored on lathes that have exceptionally high headstocks and elevated cross-slides.

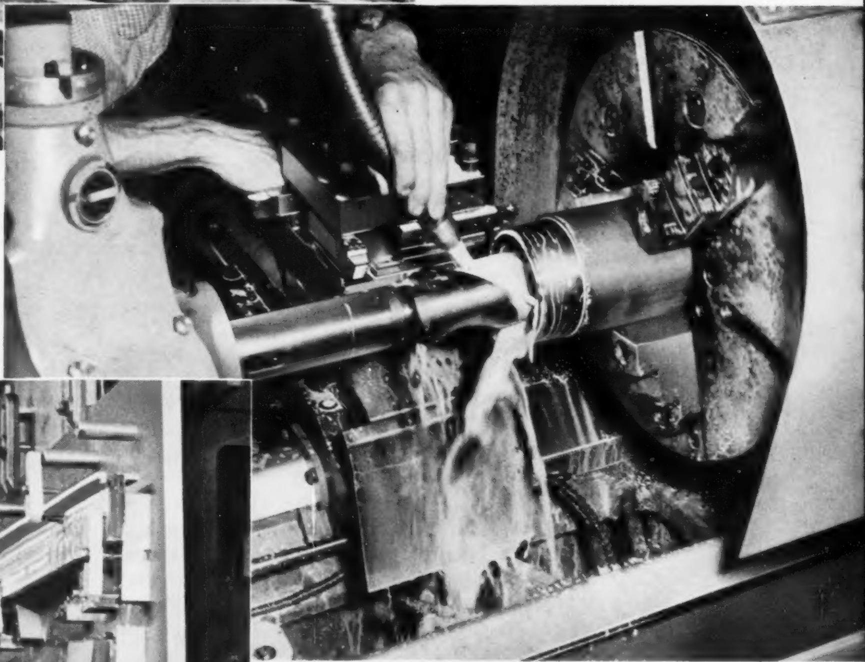
(Below) Parts such as the aluminum wing "carry through" here being produced on a Hydro-Tel milling machine must often be "carved" out of big slabs of metal.

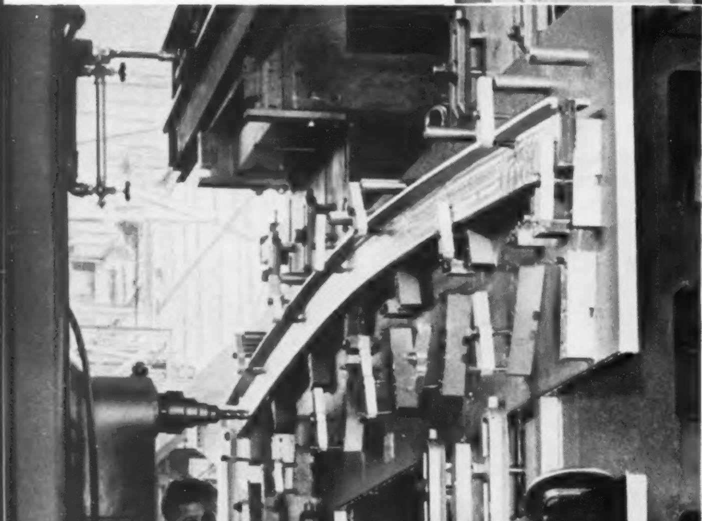


MACHINING



(Above) Gang-milling operation on a Kearney & Trecker machine in which four faces of two bosses on an aluminum landing-gear part are being finished to close tolerance limits.

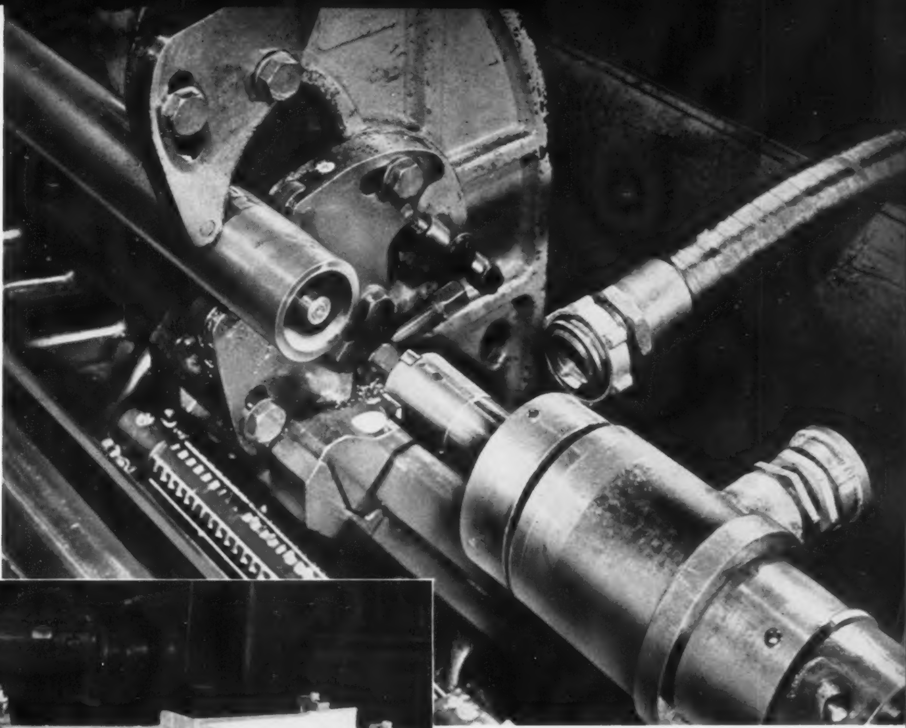




(Above) Drilling a large hole in a lathe operation performed on a landing-gear component made of SAE 4140 steel. The part runs at 22 rpm, and the feed is 0.006 inch.

(Left) Contouring two aluminum wing-assembly rib chords on a huge Cincinnati Hydro-Tel milling machine. Intricate movements of the cutters are controlled by a stylus which follows an overhead template.

AT AXELSON



(Above) Trepanning operation on landing-gear part in which a bar of Hy-Tuff steel is accurately machined to a diameter of 2 11/16 inches for a length of 33 inches.

(Above) Taking a scarfing cut on the end of a wing member on a Giddings & Lewis horizontal boring, drilling, and milling machine. Part was "sculptured" from a solid aluminum block.

(Right) Iron casting for a wind tunnel unit after being contoured internally on a Keller machine. Above the work is the plaster form used to automatically control the cutter position during the entire operation.

By C. L. HIBERT, Senior Design Engineer
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San Diego, Calif.

REQUIREMENTS for reduced weight and additional space in current and prototype aircraft have led to the production of a large number of intricately shaped parts. With the proper design, many of these components can be made with a simple and economical process—chemical milling.

Preliminary development and research at Convair indicate that this production method has broad scope. But the manner in which work-pieces may be modified to make their production by chemical milling attractive from the economic standpoint is not always evident to the designer.

Basically, chemical milling is an etching process. It is presently used to execute complex engineering designs with a simple masking technique. Templates used in a wing-tip masking operation are seen in the heading illustration. Relatively unskilled labor and unpretentious production facilities such as tanks and solutions are employed (Fig. 1). Aluminum alloy, magnesium alloy, titanium alloy, and stainless steel have all been milled chemically. Although versatile, the process is adaptable in a greater degree to sheet metal or plates than material in other shapes. Typical applications are seen in Figs. 3 and 4.

With the advent of chemical milling, a new means of dimensional control is exploited—time. Fortunately, instrumentation for this basic quantity is readily available, making tolerances easy to achieve. Moreover, many operations may be performed and regulated simultaneously.

The etching is uniform throughout the unmasked portion of the work-piece, and the depth of cut is dependent on the time of exposure to the solution. Another basic characteristic of chemical milling is that a radius approximately equal to the depth of cut is formed along the edge of the masking material (Fig. 2). In addition, the hardness of a metal does not affect the rate of its removal. This fact is interesting when considering the use of alloy steel in aircraft.

Design Considerations

Chemical milling can be performed after forming operations. Complex shapes, broad or narrow cuts, and comparatively sharp corners are pos-

DESIGNING WORK-PIECES FOR CHEMICAL MILLING

sible in one operation. However, a limiting relationship exists between the depth and the width of a cut (Fig. 2), and cuts greater than 0.25 inch may result in extreme roughness at the edges. In the case of heavy plate, which by nature of the rolling process is of coarser grain, a greater degree of roughness is produced. The process can be applied to complex contoured or formed parts, and metal may be removed from both surfaces of a sheet simultaneously. This latter operation prevents warpage in a sheet metal part.

Chemical milling permits the design of integrally stiffened sections. These lighter weight and simplified members eliminate riveting, seams, and the spot-welding of doublers. Sandwich construction appears more feasible than it has in the past, since heavy lands can be left on a panel wherever any attachment is to be made.

Sheet thickness can be held to tolerances of plus or minus 0.002 inch with chemical milling. Tolerances obtained with various depths of etch are given in the accompanying table.

Depth of Etch, Inch	Tolerance, Plus or Minus, Inch
Up to 0.030	0.002
0.031 to 0.060	0.0025
0.061 to 0.090	0.003
0.091 and over	0.004

In step-etching (Fig. 5), the tolerance must be held closely on the thinnest section. If the operator is to have the full allowance on the thin section, the heavier sections must have added tolerance. For instance, if at the conclusion of the first etch the operator makes the second cut two-thousandths shallow and then brings the thin section down to the upper allowable dimension, the second cut will be two-thousandths out of tolerance. The solution of this problem is to specify close tolerances on the thin section only.

Chemical milling permits tapering of sheets, extrusions, hat sections, and other parts suitable as stiffeners to distribute design stresses proportionally. Tapered sections are more easily produced if they exceed 5 inches in length. However, tapers with lengths as short as 3 inches have been accomplished. Bands or stiffeners can be produced integrally with the skin and may be curved or contoured so as to direct the stress transfer as desired. In addition, various depths of cut, within process limits, can be taken on large areas of one sheet by a method of progressive unmasking.

Physical and mechanical properties of the stock are not impaired by chemical milling. However, the fatigue properties may be affected by roughness and notches along the edge of cut radius. Chemical attack is uniform from any

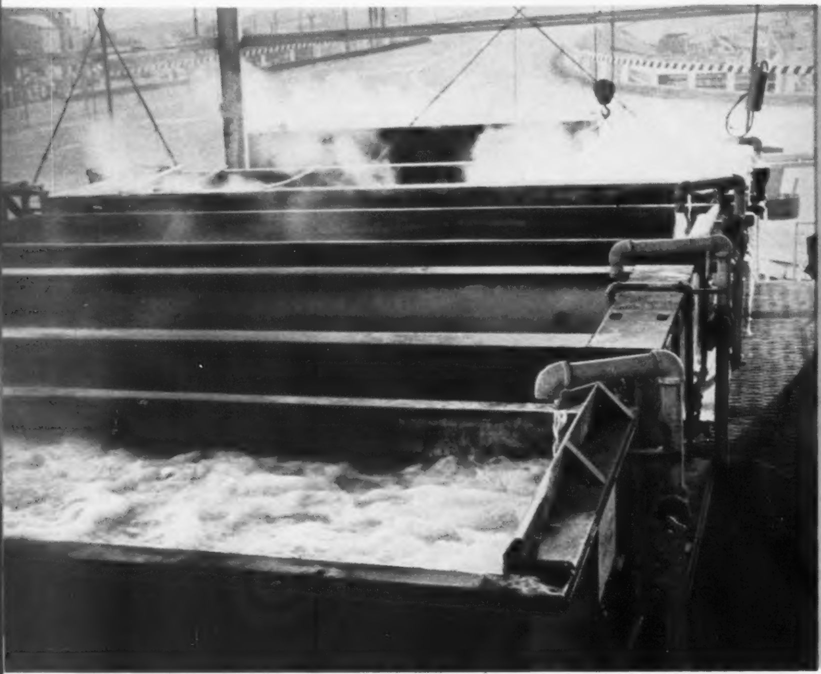


Fig. 1. Chemical milling facilities are simple, consisting primarily of tanks, hoists, pumps, and etching solutions.

point of the exposed or unmasked area. This phenomenon results in a radius at the edge equal to the depth of the material removed, as seen in Fig. 5. Therefore, the minimum width of cut must be more than twice the depth (Fig. 2).

When masking materials are to be used, the depth of cut is limited to 0.25 inch. Experimental cuts of up to 0.50 inch have been produced. With the deeper cuts, gas is trapped beneath the masking material. This gas cannot be displaced by agitation of the solution, and uneven etching in these areas results. The problem is not insurmountable, but edge roughness on heavy plates and forgings limits the depth of etch.

Chemical-milled parts require no further finishing, such as sanding and polishing, but masked edges are sharp and may require rounding. Surface roughness resulting from the etching process is in the order of 125 to 150 micro-inches. Edge grain on deep cuts will approximate 200 to 300 micro-inches. Tapering is accomplished by gradual immersion or removal of the work-piece from the solution. Surfaces as thin as 0.002 inch have been achieved with excellent uniformity.

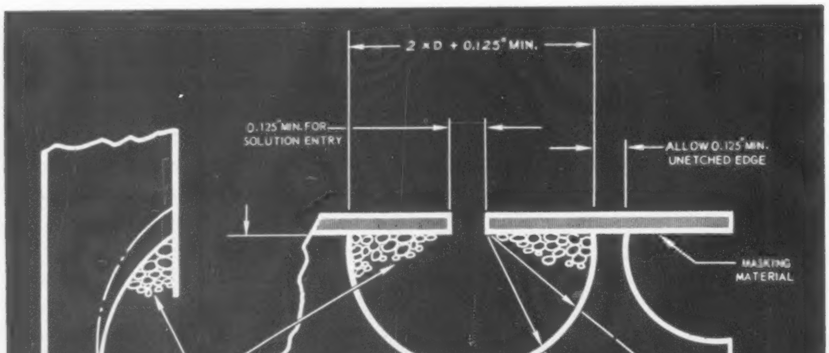


Fig. 2. A radius equal to the depth of etch forms along the edges of the cut. Gas trapped under the masking causes a roughening to occur at the radius.

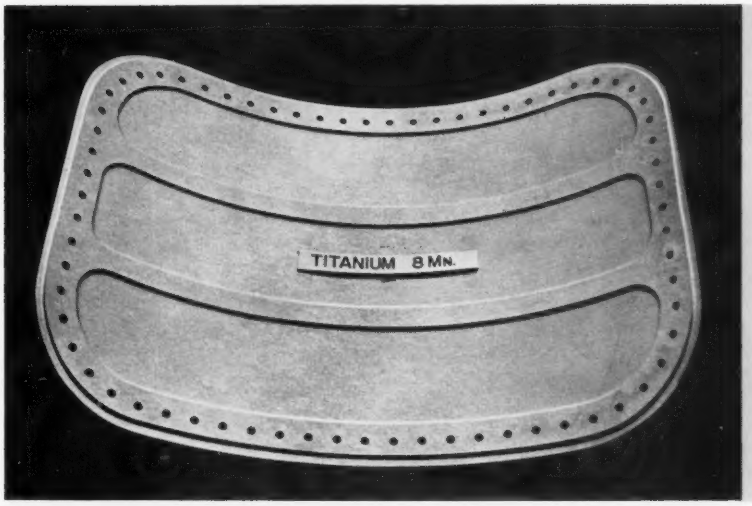


Fig. 3. Titanium alloy can be milled chemically. Components with integral reinforcement and locations requiring additional thickness of material for fasteners are readily produced.

Specific Applications

Difficulty has been experienced in designing with large-diameter thin-wall tubing of aluminum alloys, primarily because it is not commercially available. In addition, there is a limitation on the bending of such tubing that is determined by the wall thickness. With chemical milling, it is possible to produce bent sections of thin-walled ducting by reducing the wall thickness of standard tubing to the desired measurement after forming has been accomplished. The tubing may be masked on the periphery, or the ends may be plugged. However, etching of both surfaces simultaneously is satisfactory from a production standpoint. There are practical limits to chemical milling that involve the proportion between the size of the inside diameter and the length of the tube.

When designing forgings and extrusions, the thickness of certain webs and sections is determined by the nature of these processes. By chemical milling, it is possible to obtain workpieces with a prescribed wall or web thickness from forgings and extrusions. The amount of material to be removed on thin sections to meet the design requirements is calculated and added to the remaining heavier sections. Then, by chemical milling the part all over, it is possible to meet the finished dimensions. This method does not require any masking, but it does require a rotating fixture to obtain uniform etching in any deep pockets.

Convair is investigating the possibility of machining forgings and other parts to an over-all dimension somewhat larger than that specified and then chemical milling all over to the blueprint dimensions. This may eliminate some of the warpage problems.

With certain weldments, it is desirable to have an upset section in the welded area to compensate for reduced strength values in this zone. By

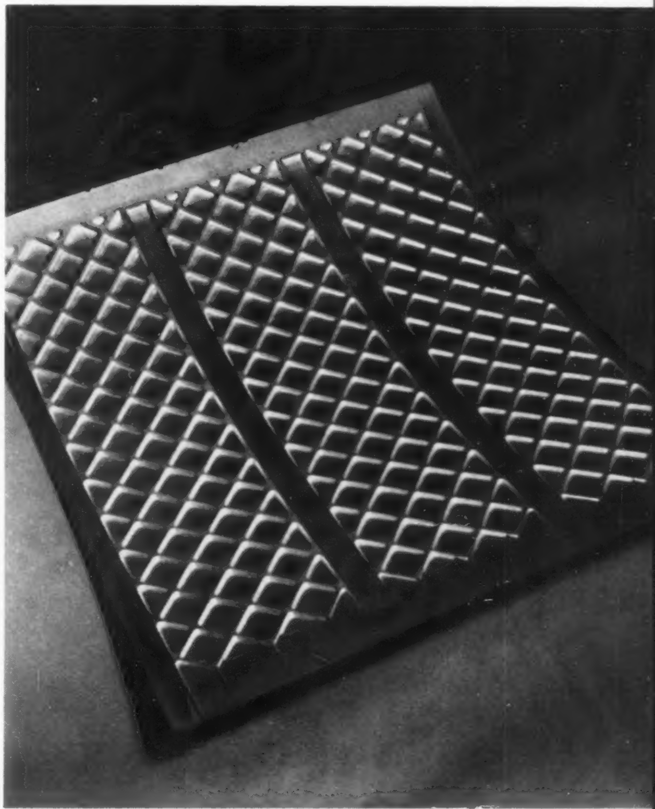


Fig. 4. This wing-tip section is chemical-milled. Masking allows removal of metal in areas of any shape to depths within the limits of the process.

the use of chemical milling, it is possible to start with a heavier gage sheet, mask the area to remain as the upset, and chemical mill the remaining area to the proper gage thickness.

A factor that often has an influence on material thickness selection is its availability in standard sizes. With chemical milling, it is possible to reduce a standard gage thickness to a lesser non-standard gage, or taper the part in one or two directions for the purpose of weight reduction.

In many cases a heavy stiffener section is required on the compression side of channels, and often an additional strip of material is spot-welded or riveted in place. It is possible to make the section integral by starting with a heavier uniform section and reducing the tension side by chemical milling. Local plastic instability in compression forming depends on the method of loading, lateral restraint, and cross-sectional area. The first two items are a tooling problem, but increasing section thickness will aid in compression forming. By utilizing chemical milling, it is possible to start with a heavier gage material.

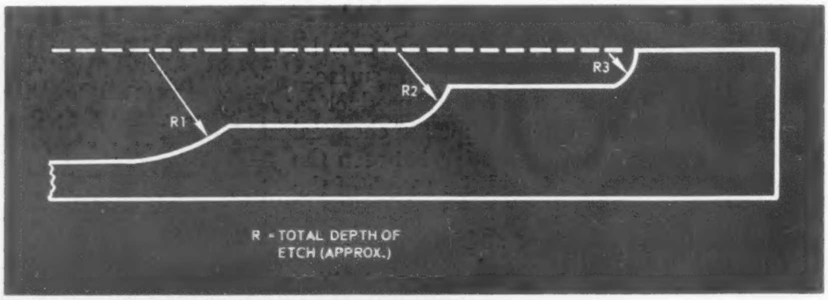
When hose clamps are used, thin-wall tubing requires additional thickness of material to reinforce the compression area. This is usually accomplished by spot-welding a strip of sheet metal on the inside surface at each end of the tube. The strip restricts the flow and increases friction. In a similar construction shown in Fig. 6, the reinforcement is the unetched portion of heavier wall tubing. The outside diameter for the remainder of the length has been reduced to the required dimension by chemical milling. Such heavier wall tubes are easier to bend with less tendency to form compression wrinkles. In addition, the reinforcement is on the outside and integral with the tube.

It is possible to form integral reinforcements for better stress distribution and provide the additional thickness that is required for countersunk head rivets or other fasteners. Such an application is shown in Fig. 7.

Clad aluminum alloys are required for spot-weld joints in order to protect contacting surfaces from crevice corrosion. From a strength-weight standpoint cladding is undesirable. However, cladding can be readily removed by chemical milling the areas of the sheet not joined to another assembly.

When producing plated screw threads in aluminum alloy, the threads can be machined to the final, standard dimensions and then under-cut an amount equal to that of the plating with a chemical milling process. As etching is the reverse of plating, the metal is removed in the same

Fig. 5. (Right) In step-etching, the edge radius varies with the depth of cut. The work-piece is unmasked for each step in sequence.



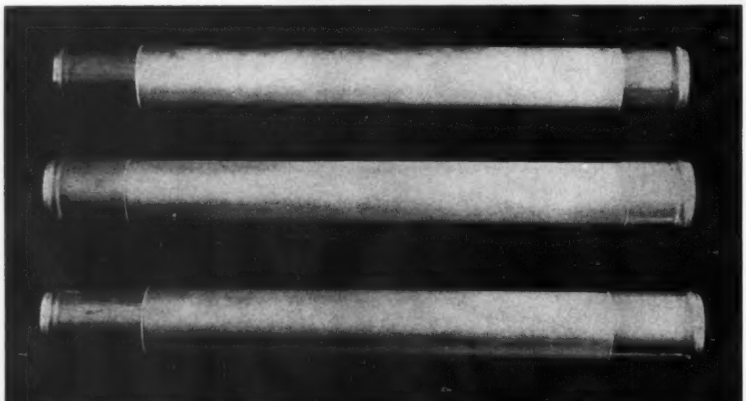


Fig. 6. (Left) Thin-wall tubes with external end reinforcement to permit the use of hose clamps are chemical-milled from heavier tubing.

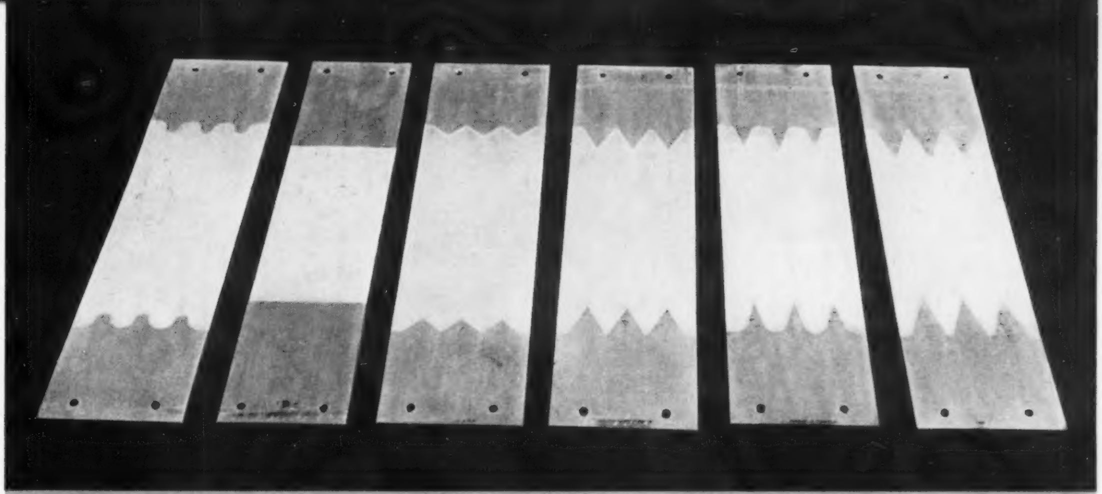


Fig. 7. Members can be provided with scalloped reinforcement along the edges in order to obtain a better stress distribution.

proportions as plating restores it to the threaded work-piece.

The operation is performed by placing the aluminum parts to be under-cut in a tumbling barrel of dilute etchant at room temperature. Epoxy chips which closely approximate the specific gravity of aluminum are then added as a separating agent. The tumbling barrel rotates at about 8 rpm. By this method the screw threads of aluminum-alloy fittings may be etched to the correct preplating dimensions. Since the amount of material removed can be gaged on one dimension, such as diameter, the need for preplate thread gages is eliminated. Necessarily, the solutions and other details of the process must be controlled.

Materials Used in Latest Type Fighter Aircraft

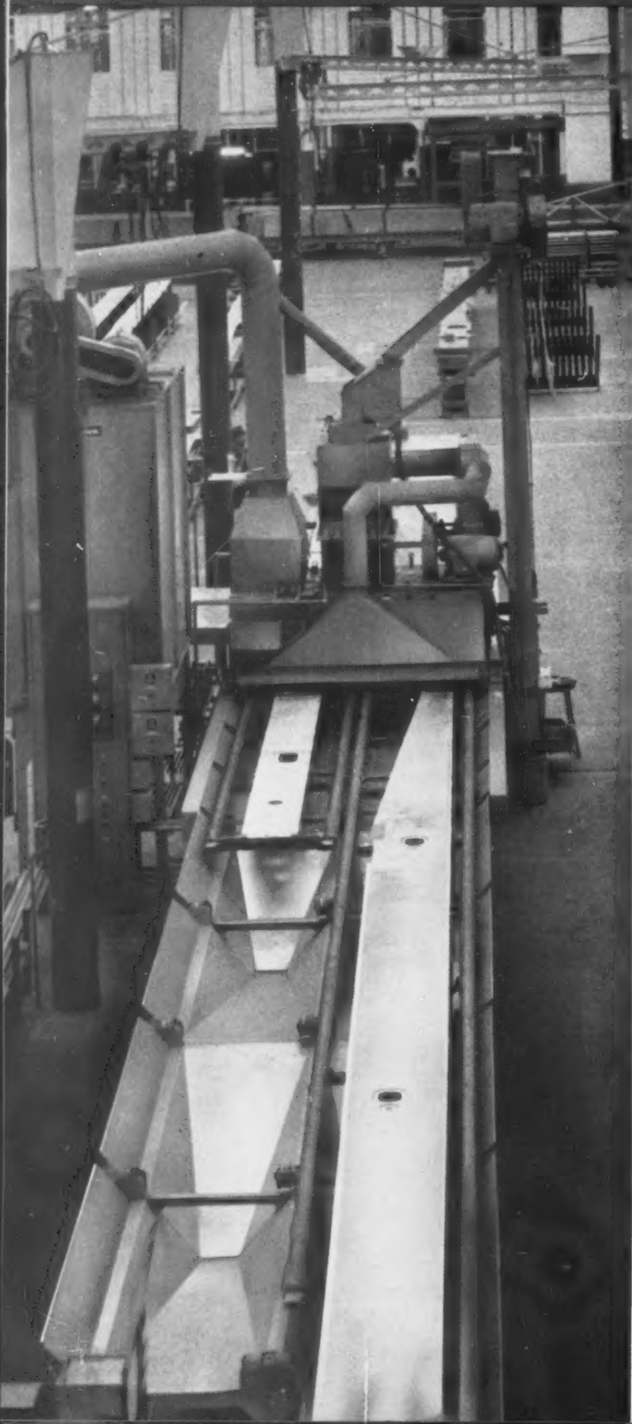
An indication of the latest trends in the application of materials in airframe construction is afforded by the F8U-1 Crusader Navy fighter, which is being built by Chance Vought Aircraft, Inc. For example, although comparatively little was known of the characteristics of titanium alloy in the initial stages of design, now—as a result of cooperation between the designers, the technical staff, and the manufacturing research department—a total of 650 pounds of titanium and titanium alloy is incorporated in each aircraft. This material is used mainly to withstand the heat generated in the aft section of the J-57 jet-propulsion unit but is also used for light, high-strength fastenings.

In addition, ferrous and non-ferrous castings have been utilized with good effect. Thus, 275 sand castings of magnesium alone are incorporated in the design with individual weights from a few ounces to 13 pounds. Wall thicknesses of 0.1 inch are not uncommon for such castings, which are frequently supplied to fairly close tolerances so that little machining is required.

Some thirty-five different precision steel castings are employed in the airframe, the majority of which are heat-treated to 180,000 psi minimum tensile strength, and twenty-five more steel castings are used in special support equipment. In general, no machining is required on these castings other than hole drilling. Also, a considerable quantity of high-strength (260,000 to 280,000 psi), heat-treated steel is being used for some fifty different parts.

Rocket-launching tubes are made from aluminum-alloy extrusions, and because this process necessitates a greater wall thickness than is necessary for strength in service, the external surfaces are chemically etched to reduce weight.

INTEGRALLY STIFFENED WING PANELS FORMED BY SHOT-PEENING



By KENNETH SPARLING
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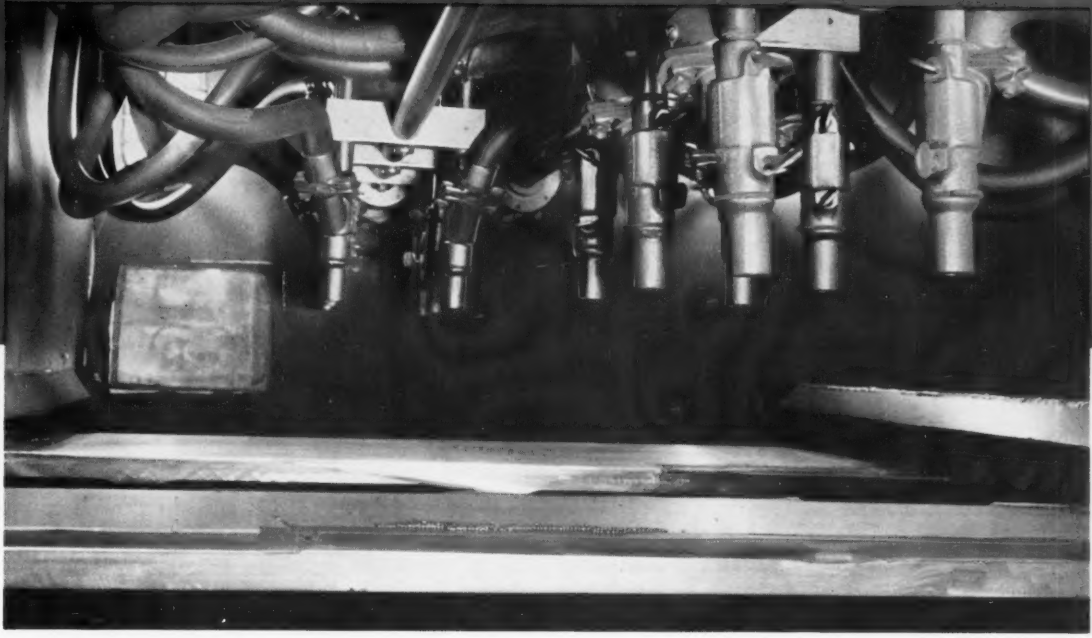
THE concept of using large panels machined from aluminum slabs to replace complex assemblies in the aircraft industry has necessitated the development of new forming techniques. During the past year Lockheed has been shot-peen forming their large, integrally stiffened wing panels with much success.

Forming is accomplished by the impact of 0.093-inch diameter cast-steel shot which is directed against the flat surface to produce a convex shape. The shot is propelled by high-velocity jets of air and makes small indentations on the surface of the work. A compressive layer about 0.020-inch deep is produced on the work surface (thick material), and a residual compressive stress of up to 50,000 psi is built up. This compressive layer tends to increase the length of the peened surface and, in doing so, causes the part to bend. As the part bends, the opposite, or concave, surface is also placed under compression until the two surfaces are in balance.

Shot-Peen Forming—a Big Step Forward

Formerly, using hot-bending methods, a single large Constellation skin required over twenty-five man-hours to contour. A 40-foot long panel now

Fig. 1. Large shot-peening installation is used to form integrally stiffened wing panels. A bucket type elevator at the right of the peening cabinet raises the spent shot 20 feet and dumps it into a separator unit.



can be shot-peen formed in approximately three hours using the installation shown in Fig. 1. This includes machine loading, masking of non-peened areas, peen-forming to contour, unmasking, and unloading. If a panel should be overformed by peening, the error can be corrected by peening the opposite side of the panel.

Tooling costs are low. Only simple, flat templates for typical contours along the length of the panel are required. Since contours do not change rapidly, templates are made for stations about 6 feet apart.

How the Curvature is Controlled

Basic control over the curvature obtained on any particular panel section is had by altering two variables—peening intensity and degree of saturation. Intensity is controlled by adjusting the air pressure that drives the shot against the work. Adjusting the traverse table speed controls the degree to which the work is saturated with shot. These controls are at the operator's fingertips at the control station, as can be seen in Fig. 2. A window in the peening cabinet permits viewing of the work while in process.

Intensity and saturation can be altered during the peening cycle to compensate for different conditions of the work-piece. A constantly changing contour can be formed regardless of changes in section thickness (from 0.050 to 0.600 inch) or location of cutouts for doors and access holes.

Saturation is attained when the part is completely covered with dimples made by the shot: a complete obliteration of the original surface. In practice, the surface of the part need not be saturated for peen-forming. An increase in the degree of saturation is accompanied by an increase in the curvature of the part.

Intensity is measured with Type "A" test specimens (MIL-S-13165). Each specimen is 3 inches long, 3/4 inch wide, and 0.051 inch thick. They are of SAE 1070 cold-rolled strip steel that has been hardened from 44 to 50 Rockwell C. A specimen is bolted to a 3/4-inch thick steel block and exposed to the shot blast.

After being completely saturated, the specimen is removed from the holder and the arc height is measured on a No. 2 test gage. The gage measures the arc height of the test specimen at the center of four 3/16-inch diameter balls that form the corners of a 1.250- by 0.625-inch rectangle. If, for example, the measurement were 0.015 inch, it would be written as 0.015 A2. Increasing the intensity of the air flow will increase the curvature obtained.

Secondary Control of Curvature

In addition to the primary operating controls for saturation and intensity, secondary controls can be varied to influence part curvature. Distance between the discharge nozzles and the work surface can alter the resultant curvature. An increase in distance lessens the intensity and decreases the saturation for a given table speed

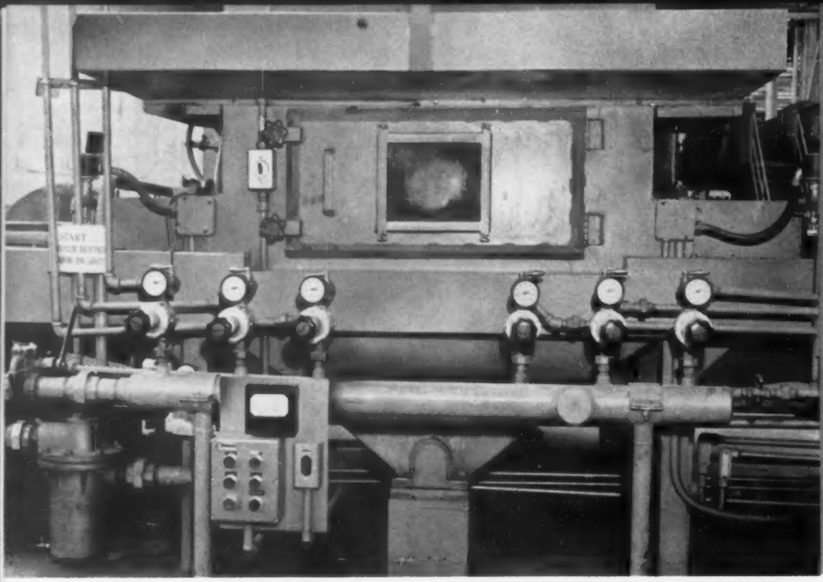


Fig. 2. One of two operating stations at the cabinet section of a large shot-peen forming installation. Pressure regulators and gages provide individual control for each of six nozzles.

and air pressure. The nozzles can be tilted to match the angle of the parts so that the shot blast will be normal to the surface. If normality is not maintained, maximum curvature will not result.

Smaller shot may be used, but the curvature obtained on aluminum alloys will not be as great as when using large shot at the same intensity. Nozzle size can also be changed to alter the saturation and area of coverage. The gates that control the flow of shot to the feed hoses can be opened or closed. By opening these gates, the flow of shot is increased—but only up to a certain point. After this point is reached, the quantity of shot delivered is lessened and the flow becomes sporadic. All of these secondary controls are normally set at an optimum position and are not changed unless configuration of the parts varies radically from one to the other.

The peen-formed curve on any part depends entirely on operator judgement. No two parts react to the shot blast in exactly the same manner. Fortunately, normal tolerance on commercial wing panels requires that the gap between part and templates does not exceed 0.030 inch.

Other Effects of Shot-Peen Forming on Work-Piece Material

Severe iron contamination can cause surface corrosion of 7075-T6 aluminum alloy. To prevent this, and to remove any other foreign material that may have accumulated on the part, the panels are cleaned with a mild caustic solution immediately after peening. The panels are then given an Iridite corrosion-resistant treatment before painting and assembly.

Mechanical properties of 7075-T6 aluminum alloy are not radically altered by shot-peening. Although the ultimate tensile strength is not changed, the yield point is reduced somewhat depending on the material thickness. Tests have shown reductions of up to 7 per cent on 0.040-inch thick material, and up to 1 per cent on 0.500-inch thick material. Fatigue strength is improved slightly. Corrosion resistance is greatly improved due to the residual compressive stress in the surface of the peen-formed part.

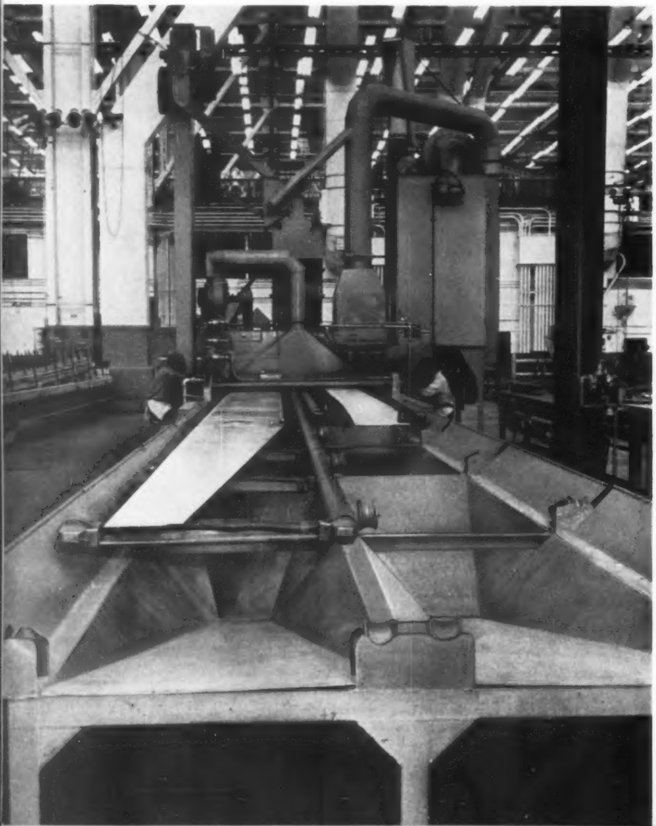


Fig. 3. The machine bed supports two 45-foot long tables that can be operated either individually or in unison. One operator at each of two control stations supervises the forming of each integrally stiffened wing panel.

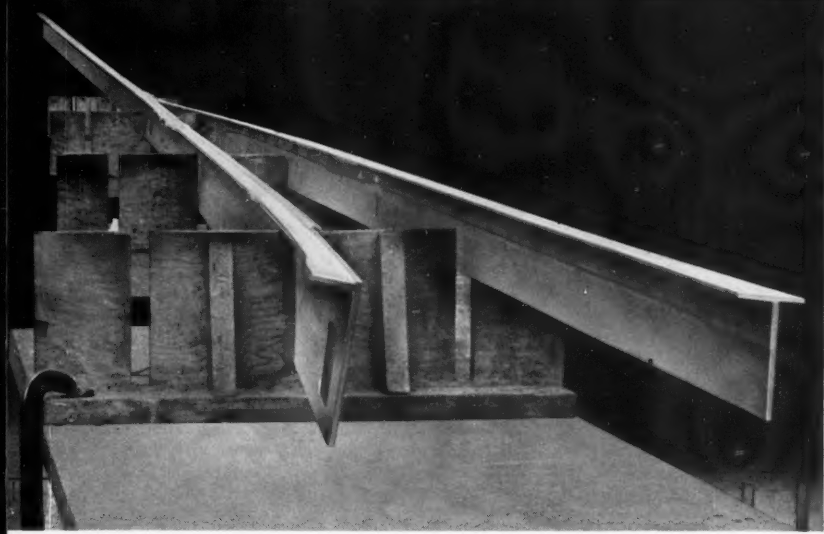


Fig. 4. Shot-peen forming installation can be used for emergency salvage operations. At the left is a long wing beam cap distorted during machining. At the right is a similar part after straightening by shot-peening.

Peen-Forming Machine is One of the Largest

The Lockheed peen-forming machine is one of the largest in existence. Over-all bed length exceeds 85 feet. Two tables are provided, Fig. 3, and can be operated either separately, accommodating two panels up to 33 inches wide and 45 feet long, or as a single unit, accommodating a part up to 6 feet wide. The tables can be driven at infinitely variable speeds from 3 to 38 inches per minute. A secondary rapid traverse speed of 215 inches per minute is provided for quick part positioning.

All forming takes place within a rubber-lined peening cabinet that covers a 4-foot length of the work-piece. The cabinet interior is illuminated and the operators (one on each side of the cabinet to handle each table) view the work through windows. There are six air-blast nozzles for each half of the machine, as shown in the heading illustration. Each nozzle has a separate pressure regulator and shut-off valve for controlling peening intensity.

The two groups of six nozzles are mounted on separate bars that are oscillated by two Bellows air cylinders. Position and length of the stroke can be controlled for lengths up to 15 inches by setting adjustable stops. Speed of oscillation can be adjusted by an air-pressure regulator at each operator's station.

As might be expected, the work surface does not have a smooth appearance. In the most severe forming operations, the surface roughness may go as high as 250 micro-inches. If objectionable, the surface can be sanded to remove a maximum of 0.002 inch from the top of the peening marks. The work contour will not change appreciably, providing that no material is removed from the bottom of the peening dimples.

Use of the shot-peening installation is not restricted to the contouring of panels—it can be used for emergency salvaging operations. As an example, some 50-foot long wing beam cap extrusions were badly distorted as a result of machining (left, Fig. 4). This long, curving distortion in the T-shaped member was so severe that it could not be forced into the assembly jigs without causing ripples in the thin web section. The finish-machined parts would have been scrapped, but by shot-peening the cross of the tee they were satisfactorily straightened for use (right, Fig. 4).

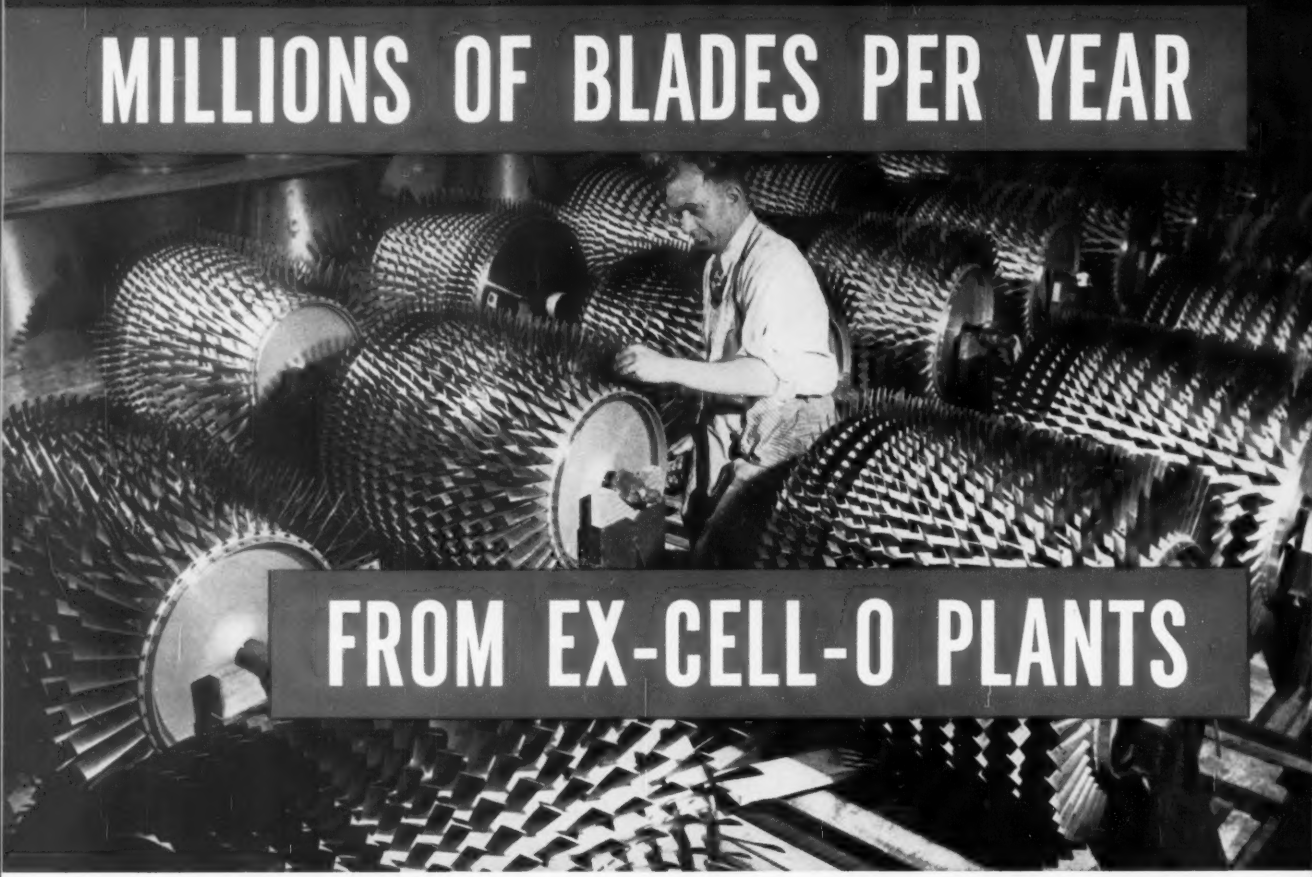
Imperfect Shot is Rejected

All shot is handled in a closed system that automatically rejects broken or under-size pellets before they can be used again. After peening, the shot drops to the bottom of the cabinet. A mechanical screw carries it out of the cabinet and into a bucket type elevator which raises it about 20 feet, then dumps it into a separator unit. The elevator can be seen by referring to Fig. 1. It is the upright structure shown at the right-hand side of the cabinet.

Rejection is accomplished within the separator unit by spreading the shot evenly over an inclined flat plate. As the pellets leave the end of this plate, the broken and light shot (which do not move as fast as the undamaged shot) are diverted from the main flow into a reject section by a knife. The reject section of the separator is connected to a dust collector (left-hand side, Fig. 1) that removes any dust or other small foreign particles from both the separator and the main peening cabinet.

After the acceptable shot has by-passed the separator knife, it passes through a screen—to prevent any large foreign particles from flowing into the nozzles—and into a hopper. There is a short horizontal run in each feed hose that restrains shot flow until the driving air is turned on for each nozzle.

MILLIONS OF BLADES PER YEAR FROM EX-CELL-O PLANTS



Photo, courtesy of General Electric Co.

Ultra-modern facilities are employed to manufacture precision compressor blades for jet-aircraft engines from titanium and stainless-steel alloys on a mass-production basis

By E. HUGH JONES
Ex-Cell-O Corporation
Detroit, Mich.

PRECISION parts and assemblies represent more than 40 per cent of the Ex-Cell-O Corporation's sales. Among many items for jet-aircraft engines, the company manufactures precision compressor blades in large quantities. A constantly increasing demand for such blades has made it necessary to expand existing facilities.

Compressor blades are now being produced at two Ohio plants—in Lima and Fostoria—and at a recently acquired plant in Elwood, Ind. These plants produce millions of blades per year from various stainless-steel and titanium-alloy forgings for the J-57 and J-75 turbo-jet engines made by Pratt & Whitney Aircraft and Ford's Aircraft Engine Division; Allison's J-71; General Electric's J-79; and the T-34 and T-56 turbo-prop engines made by Pratt & Whitney Aircraft and Allison, respectively.

Also, pre-production and experimental blades are made for all these engine manufacturers. The blades vary from approximately 3/4 to 14 inches in length. A few of the different types of root forms produced are illustrated in Fig. 1. All surfaces of blades made from stainless-steel alloys are finished by grinding. Titanium-alloy blades, however, cannot be ground because of the danger of inducing surface cracks due to heating, and are finished by machining.

From 0.030 to 0.060 inch of stock is provided on the airfoil surfaces of the forgings for subsequent removal, and from 0.060 to 0.100 inch on the root surfaces. The forgings are first qualified

by straddle-milling the root sections, milling the tip on the outer end of the airfoil section, drilling locating holes in the ends of the root, and center-drilling the tip. These operations are performed on a modified Ex-Cell-O double-end boring machine equipped with carbide milling cutters and high-speed steel drills.

The root forms of titanium-alloy blades are finished to size by broaching in two passes. A typical setup on a Lapointe 15-ton, 90-inch stroke broaching machine is seen in Fig. 2. With the forging clamped in the right-hand fixture, the dovetail form is broached in the first pass. Then, the part is transferred to the left-hand fixture, and the tongue form is completed in the second pass.

A ram speed of 22 feet per minute is used to remove from 0.060 to 0.100 inch of stock with high-speed steel broaches. The pressure-angle surface on the root form is held to a tolerance of plus or minus 0.0003 inch. Also, the surface finish produced in broaching is maintained within 60 micro-inches. The broached surfaces are used for locating during all of the subsequent operations.

Airfoil surfaces, including leading and trailing edges and the fillets where the airfoil joins the root platform, are machined automatically on an Ex-Cell-O profile miller. As seen in Fig. 3, the blade root is clamped in a two-jaw chuck, while the locating tip on the outer end of the airfoil section is supported by a tailstock center. Steadyrest rollers are hydraulically held in contact with the work to resist the cutting pressure, thus minimizing deflection of the blade.

The milling spindle is mounted at an angle on a slide beneath the work. A carbide-tipped milling cutter, made by the Continental Division of Ex-Cell-O, is rotated at a cutting speed of 400 surface feet per minute. The work does not rotate, but travels lengthwise across the milling cutter at the rate of 1/2 inch per minute. The chuck, tailstock, and steadyrests are locked hydraulically during cutting, but are released at the end of each stroke to permit indexing the work. Cutting and indexing are successively repeated until the blade has been indexed 360 degrees.

An accurately ground barrel-cam, mounted on the left-hand end of the machine work-head (Fig. 4), controls the vertical movement of the cutter to reproduce the required airfoil form. These precision hardened and ground cams are made from masters of laminated construction. The masters are made up of alternate aluminum and steel segments that are accurately finished on a template grinder and fitted together. The templates are made from enlarged glass layouts of various sections of the airfoil contour. The roll follower can be seen directly below the cam. From 0.030 to 0.060 inch of stock is milled from the airfoil surfaces in this operation, bringing the blades down to the high limits of the blueprint tolerances in the case of titanium blades. For stainless-steel blades, grinding stock is left on the work for subsequent removal.

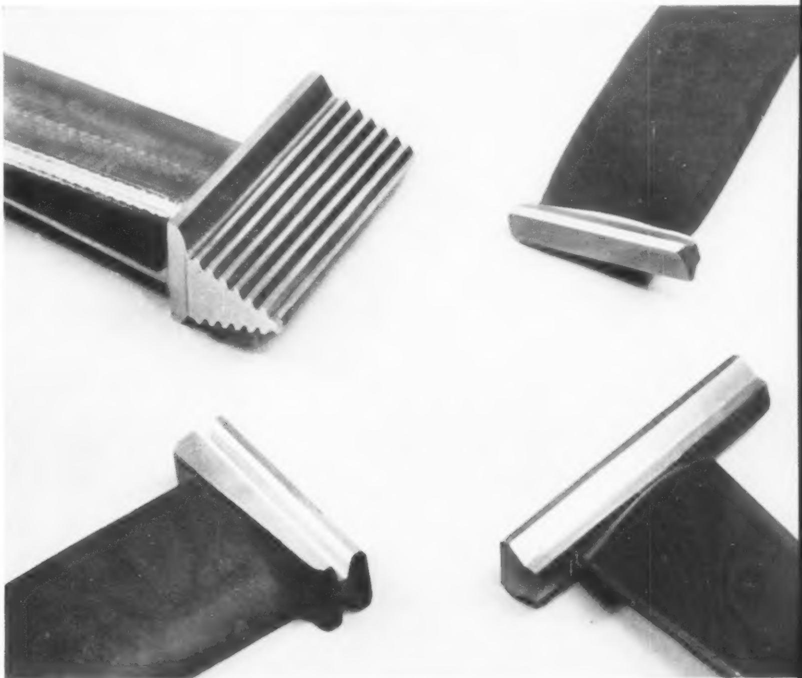


Fig. 1. Various types of root forms produced on compressor blades. Titanium blades are finished by machining since grinding is not permitted.

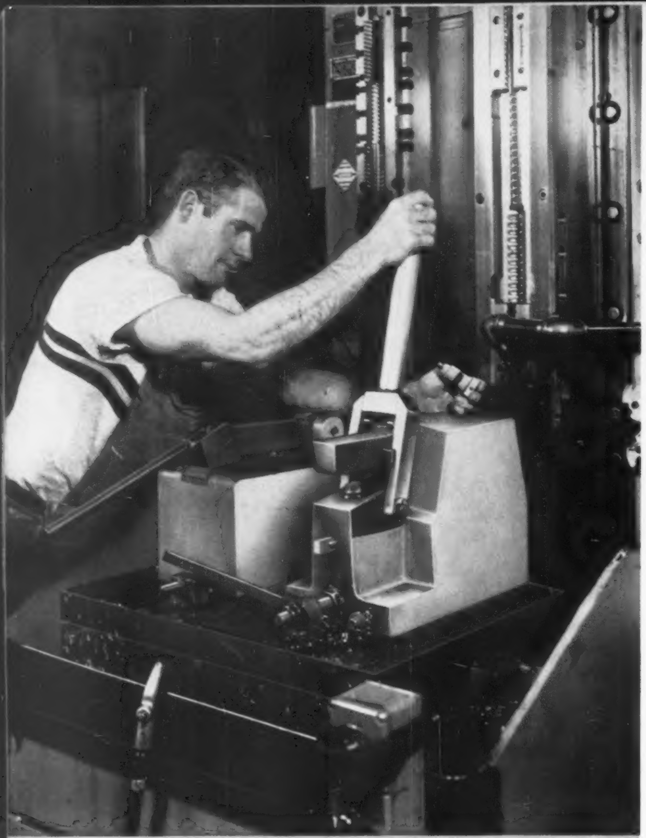


Fig. 2. Root forms of titanium-alloy blades are broached in two passes—one pass for cutting the dovetail form and the other for completing the tongue form.

Since the titanium-alloy blades cannot be ground, they go directly to an Ex-Cell-O polishing machine, Fig. 5. Here, the airfoil surface is precisely semifinished by means of a resin bonded, silicon-carbide abrasive belt of 100 grain size that is traversed at the rate of 2700 feet per minute. The work is again held in a two-jaw chuck and supported by a tailstock center, with the contour controlled by a master cam. From 0.002 to 0.004 inch of stock is removed from the airfoil surfaces in this operation.

Airfoil surfaces of the titanium blades are finished on the Hammond six-station, automatic rotary machine seen in Fig. 6. The operator loads and unloads blades from the universally mounted, reciprocating work-holders at one station. As each blade is automatically clamped and hydraulically indexed to successive stations, it is polished by progressively finer abrasive belts. Two belts—one above and the other below the blade—are provided at each station. For one particular blade, the abrasive belts at successive stations are 80, 120, 150, 240, and 320 grit. At present, aluminum-oxide abrasive belts are used, but it is planned to change to silicon-carbide abrasive for future polishing operations.

Total stock removal in this finishing operation is about 0.0015 inch, and a surface finish of 8 micro-inches or less is produced. Each belt, supplied from a 50-yard long reel, is automatically indexed periodically to present a fresh abrasive surface to the blades. A light, straight oil is used as a coolant and to wash the abrasive particles

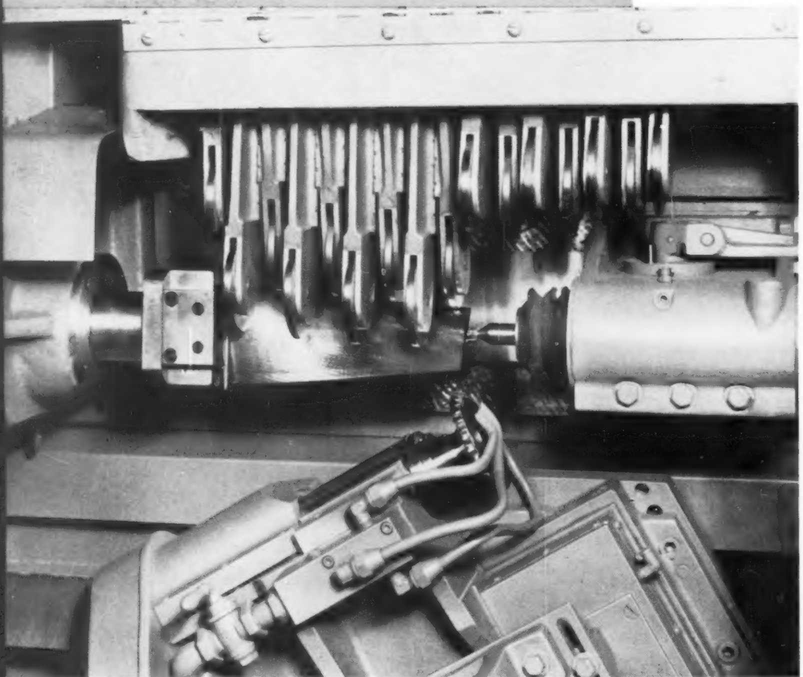


Fig. 3. Close-up view of a profile-milling machine for cutting the airfoil surfaces of compressor blades. Steadyrest rollers resist cutting pressure to reduce deflection.

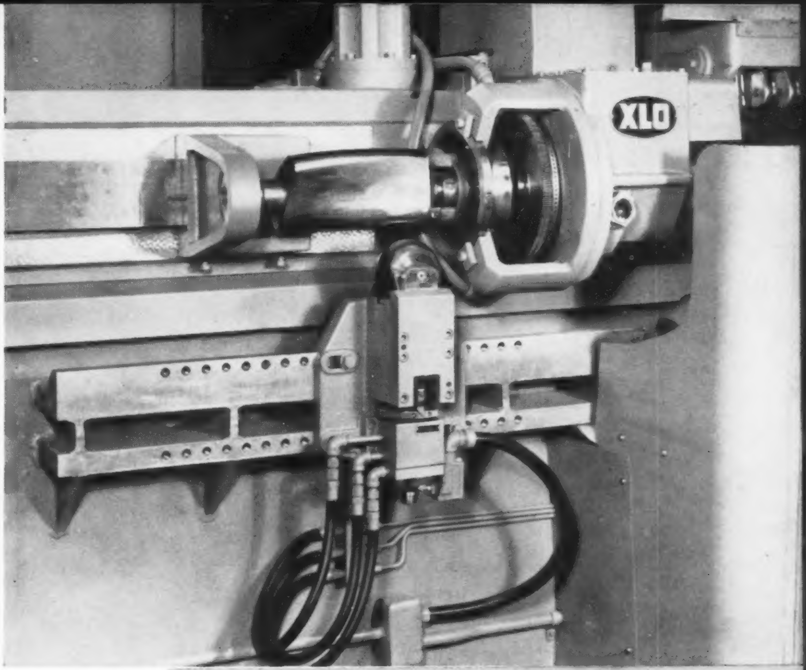


Fig. 4. Precision cam on the left-hand end of the profile-milling machine work-head controls contour cut on the compressor blade forging.

away. This machine can produce up to 360 blades per hour.

Locating tips on the outer ends of the airfoil sections are sheared from the titanium blades on a Niagara 2 1/2-ton press. In this same operation, a radius is formed on the outer edge of the blade. It has been found unnecessary to heat the titanium blades, as satisfactory results are being obtained with cold-shearing.

Stresses induced in the titanium blades during machining are relieved by heating to a temperature of 1050 degrees F. in a controlled-atmosphere electric furnace. The oxide film produced on the blade surfaces during stress-relieving is removed by Liquid Honing in the Vapor Blast four-station rotary machine shown in Fig. 7. Two blades are loaded at each station, one held by a spring clamp over the root to expose the airfoil section, and the other placed over hard rubber rollers and under a pad to expose the root only.

As the blades are automatically indexed to succeeding stations, they are blasted by an abrasive-water solution containing 14 gallons of 200-grit Pangbornite abrasive to 50 gallons of water, plus 6 ounces of a rust inhibitor. Two stationary guns blast the root sections, and two reciprocating guns blast the airfoil sections.

After etching the titanium blades in the acid bath seen in the foreground of Fig. 7, their root sections are further stress-relieved by peening. Steel shot 0.010 inch in diameter is used for peening. This operation is performed on a Wheelabrator slinger type blasting machine having a continuous belt conveyor equipped with sixty-two work-holding fixtures. The fixtures mask the airfoil sections of the blades while the roots are being blasted.

Compressor blades made from corrosion- and

Fig. 5. About 0.003 inch of stock is removed from the airfoil surfaces of titanium blades by polishing with a 100-grit belt traveling at 2700 feet per minute.

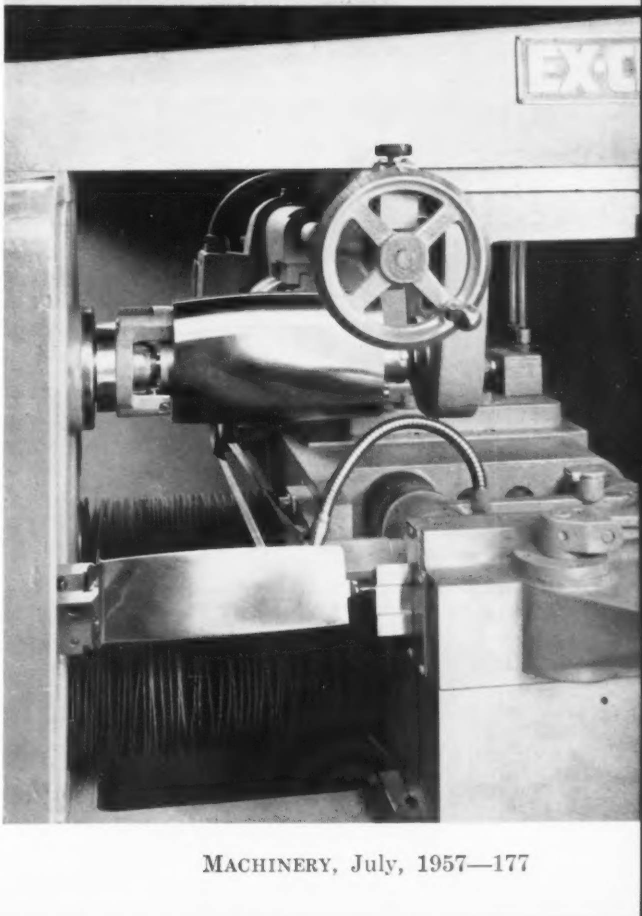


Fig. 6. Six-station rotary machine for automatically finishing airfoil surfaces. Blades are completed at the rate of 360 per hour.

Fig. 7. Abrasive-water solution is blasted on titanium blades in this four-station rotary machine to remove the oxide film that has been produced during stress-relieving.

heat-resistant steels such as AMS 5613 and 5616 are heat-treated to a hardness of 45 to 48 Rockwell C, and drawn back to a hardness of 32 to 38 Rockwell C, prior to machining. After rough-broaching, the root sections of the stainless-steel blades are ground on Ex-Cell-O two-wheel form-grinding machines like the one shown in Fig. 8. Both sides of the root form are ground simultaneously in a completely automatic cycle. All that the operators are required to do is manually load and unload the work-pieces.

The blades are located and clamped in removable type shuttle blocks which reciprocate between the grinding wheels for a predetermined number of passes at an adjustable speed. At the end of each stroke, the wheel-slides feed in until they engage positive stops which control size. When the cycle is completed, the work returns to the loading position, coolant flow stops, the fixture is unclamped, and the feed mechanism is reset for the next cycle.

Vitrified-bond, aluminum-oxide abrasive wheels of 100 grain size are used. The wheels, 24 inches in diameter by 5/8 inch wide, are automatically trued after grinding three parts by two cam type diamond dressers. To change from one root to another, it is only necessary to install new dresser cams and grinding wheels of suitable width. A cutting speed of 600 surface feet per minute is used, and from 0.008 to 0.012 inch of stock is removed from each side of the blade root.

Steel blades are returned to the broaching ma-

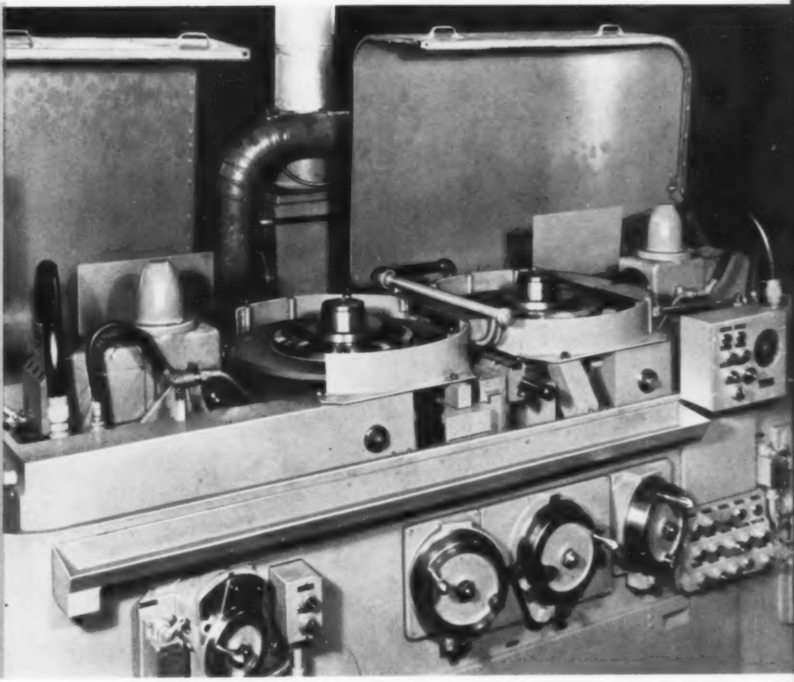


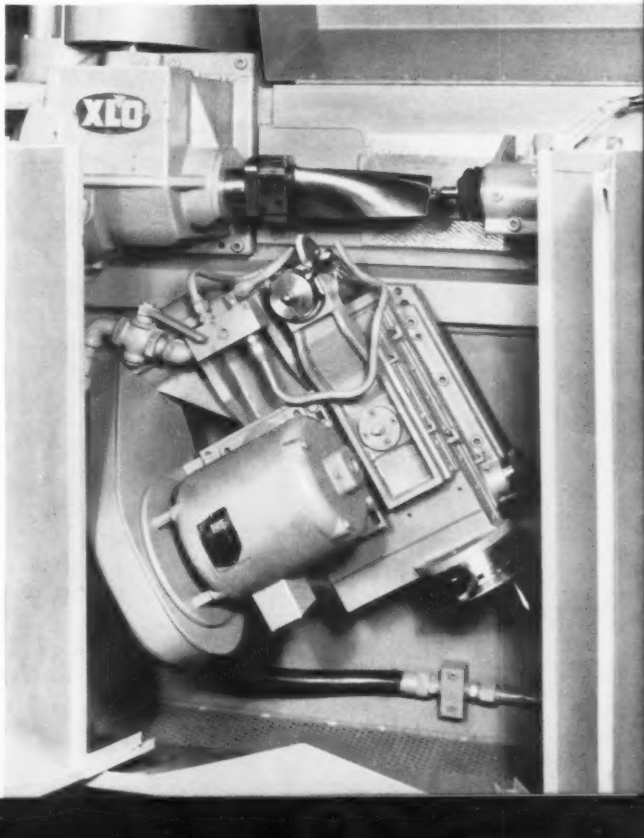
Fig. 8. Two-wheel form-grinding machine for finishing both sides of compressor blade root forms in a completely automatic cycle.

chines for finishing the tongue and stage surfaces between the roots and airfoil sections. Then, the airfoil surfaces are machined on profile millers similar to those used for titanium blades (Fig. 3). Grinding machines similar to the one seen in Fig. 9 are used to semifinish the airfoil surfaces. From 0.008 to 0.010 inch of stock is removed from each side of the blade in this semifinish grinding operation.

The operation of the airfoil surface grinding machines is basically the same as the profile millers except that the work rotates as it is traversed across the wheel at an adjustable rate. Cams and followers at the left-hand end of the machine work-head control the form ground on the blade. Work movement at the fillet (where the airfoil joins the root platform) is controlled by a face-cam, and a drum type cam controls the rise and fall of the work-head. Steadyrests are not required during grinding, because the blade is rotated and the pressure of the wheel is not sufficient to cause deflection.

Since the area of contact between the work and the grinding wheel is quite large on the broad faces of the blade, and relatively small at the leading and trailing edges, the work speed is automatically changed as the blade rotates. A vitrified-bond, aluminum-oxide abrasive wheel of 60 grain size is used. The wheel is 3 inches in diameter by 5/8 inch wide. After polishing and shearing off the locating tips, the blades are ready for inspection.

Fig. 9. On this airfoil surface grinding machine the stainless-steel compressor blade is rotated as it is being traversed across the abrasive wheel at an adjustable rate.



VAPOR BLASTING DEBURRS AND BLENDS MACHINED SURFACES

North American F-100D Super Sabre

Smooth, blended surfaces are obtained by spraying work-pieces with a mixture of water, abrasive particles, and compressed air. Process is continuous, the parts being carried through the machine by a conveyor system. The surface finish produced on wing panels can be varied to suit different specifications.

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and
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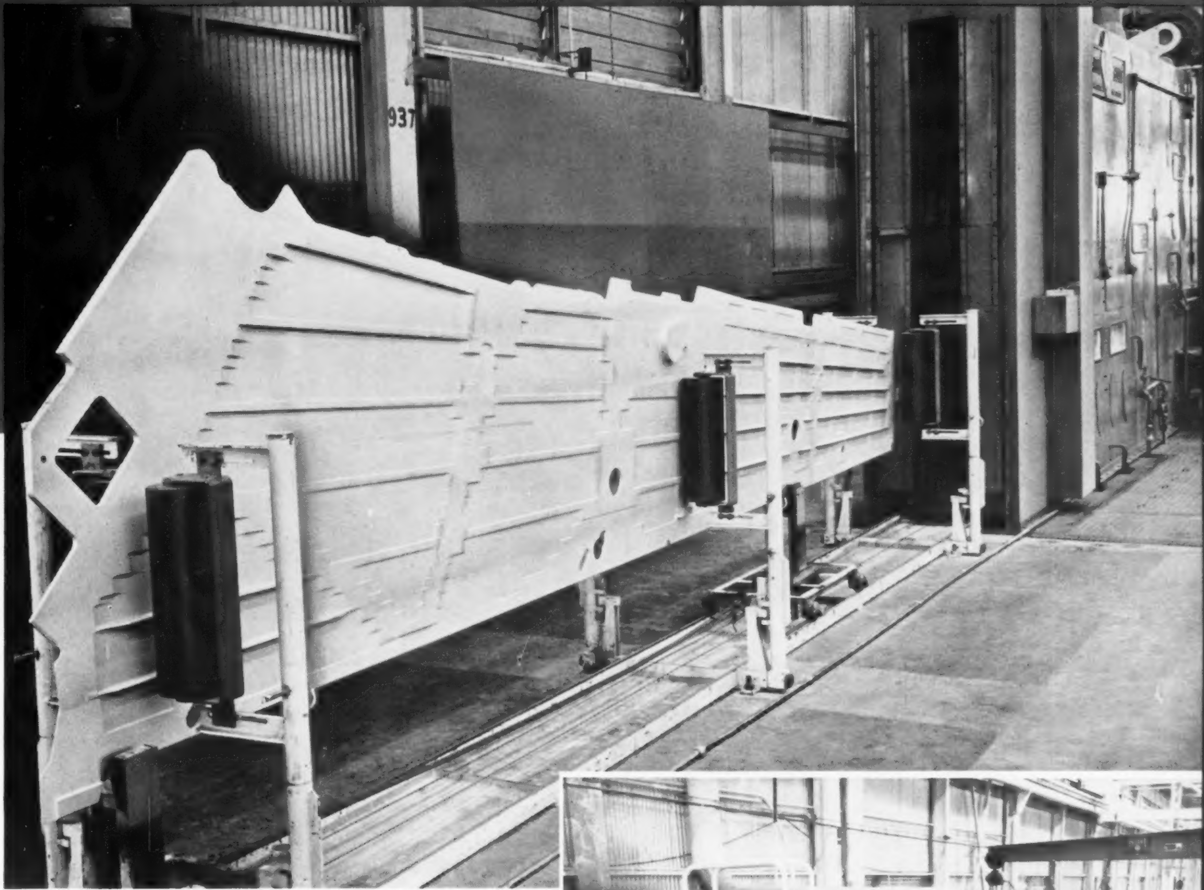
THE wing panel of a North American F-100D Super Sabre is an integrally stiffened one-piece structure that requires considerable machining. When completed, these cuts must be deburred and blended to meet the exacting tolerances specified.

Originally, such operations, being manually performed, were very time-consuming. Today, a 73 per cent reduction in labor cost is realized by deburring and blending these large wing panels in an automatic vapor-blasting machine, Fig. 1, made by the Vapor Blast Mfg. Co., Milwaukee, Wis. At the same time, a higher quality part is produced.

Vapor blasting, or Liquid Honing, as it is sometimes called, is accomplished by forcing water and an abrasive mixture through a nozzle by means of compressed air. The abrasive mixture in the resulting high velocity blast creates a cutting or peening action on the parts being processed. Different finishes can be obtained by using fine or coarse abrasives, or by adjusting the distance between the nozzle and the surface of the part. The medium-fine abrasive used for vapor blasting the subject skins removes any tool marks that have been produced during machining, as well as any burrs formed. Also, this processing leaves the metal with a smooth surface having a satin-like finish.

In processing a skin with the vapor-blasting equipment, the work-piece is first loaded onto a set of holding dollies that run on a track through



the machine. Then, the operator hooks the dollies by means of a clamping device to a conveyor cable that runs between the tracks. A wing panel loaded on the dollies and ready to enter the machine is illustrated in Fig. 2. The cable travel can be regulated for any desired speed by adjusting the motor unit. The average speed when blasting wing skins is 17 inches a minute.

After the skin is placed on the dollies and started through the machine, the work-piece enters the area where the actual vapor blasting is performed. Along each side of the machine there is a vertical, oscillating slide that carries the spray nozzles.

Drive units for the slides are shown in Fig. 3. In moving along the track, the part passes in front of these oscillating nozzles which apply the blasting solution at a pressure of 100 psi.

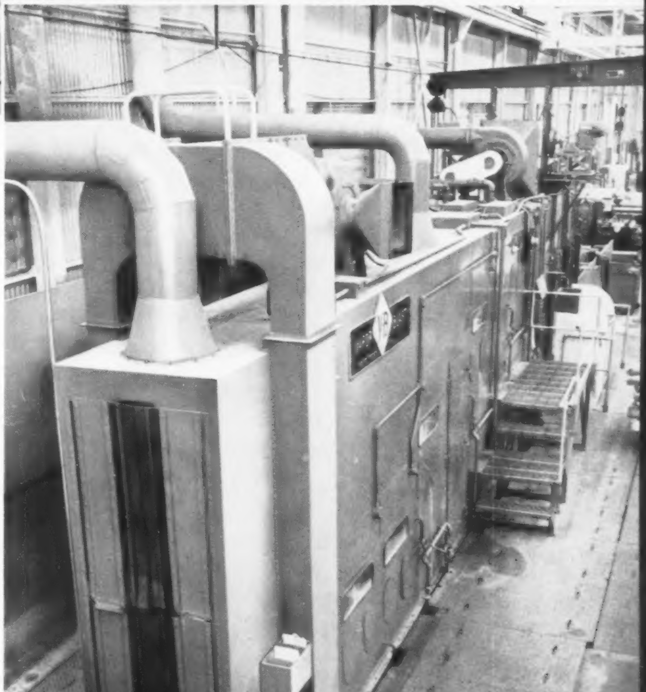


Fig. 1. Automatic vapor-blasting machine is 41 feet long by 3 feet wide by 9 feet 9 inches high. Since the process is continuous, the length of part that can be vapor blasted is not limited by the machine.

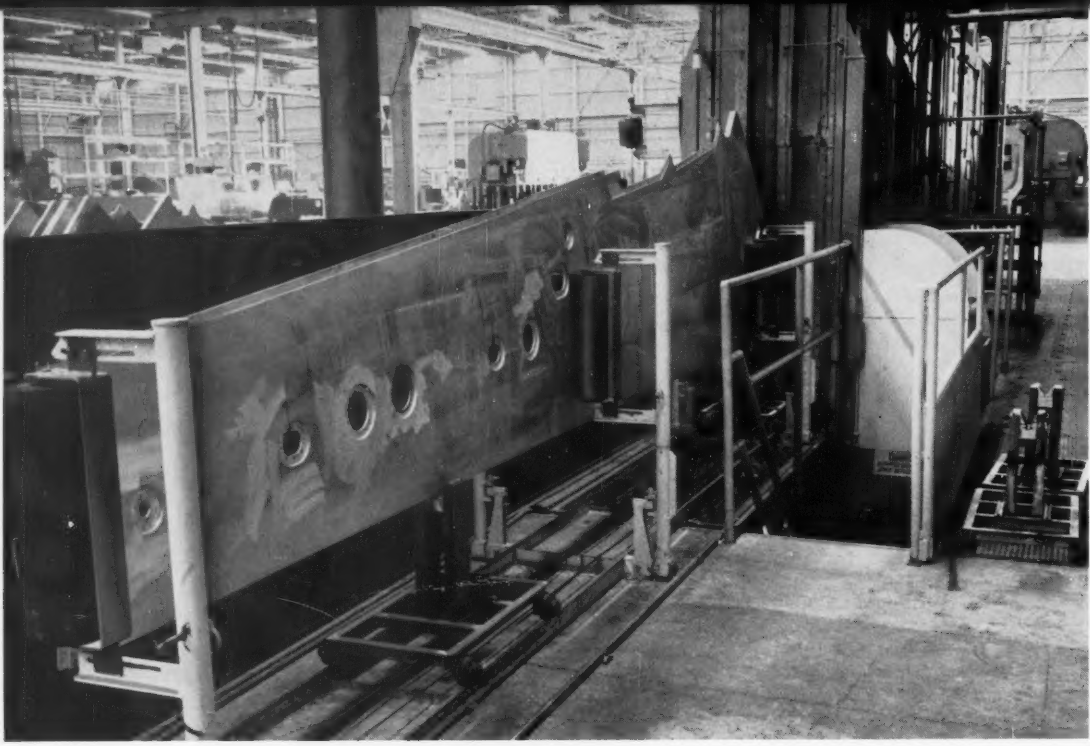


Fig. 2. For vapor-blasting, the rough skin is loaded on dollies attached to a conveyor cable. Part is ready to enter the blasting station. Rubber rollers support skin during its passage through the machine.

There are six nozzles on each side of the machine, 10 inches apart. They are located about 7 1/2 inches away from the surface of the skin as it travels through the blasting station. The nozzles travel 10 inches vertically on each stroke of the oscillating slide and, in addition, rotate back and forth to give an even blasting of the surfaces. A number of the spray nozzles are illustrated in Fig. 4.

The next station in the machine is a rinse station. Here, the part is washed with water under high pressure in order to take off the excess blasting solution. As the part enters this station, rinse water is sprayed onto the skin from both sides of the chamber. Two rinse stations, about 6 feet apart, wash the skin twice thoroughly before it enters the drying station. One of the rinse stations is shown in Fig. 5. The water used to rinse the skin is heated to about 110 degrees F. This helps to dry the part after it leaves the rinse station. The fluid drained from the rinse operation is collected in settling tanks to separate

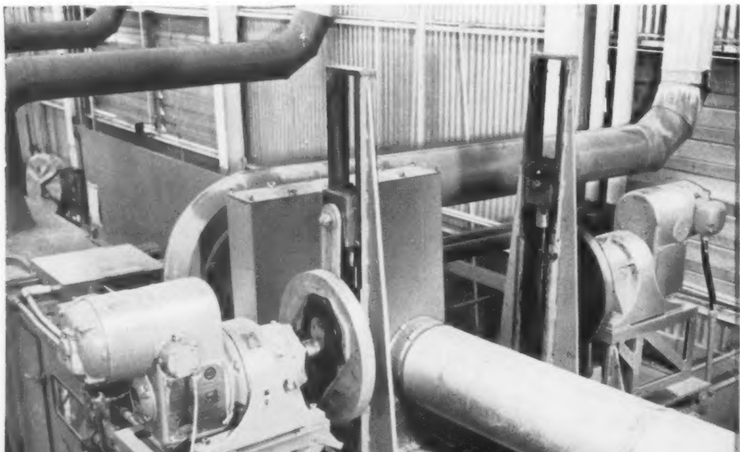


Fig. 3. Twin drive units, one for each side of the machine, are cam-regulated for various speeds to oscillate the vertical slides which carry the spray nozzles. Slides operate simultaneously.

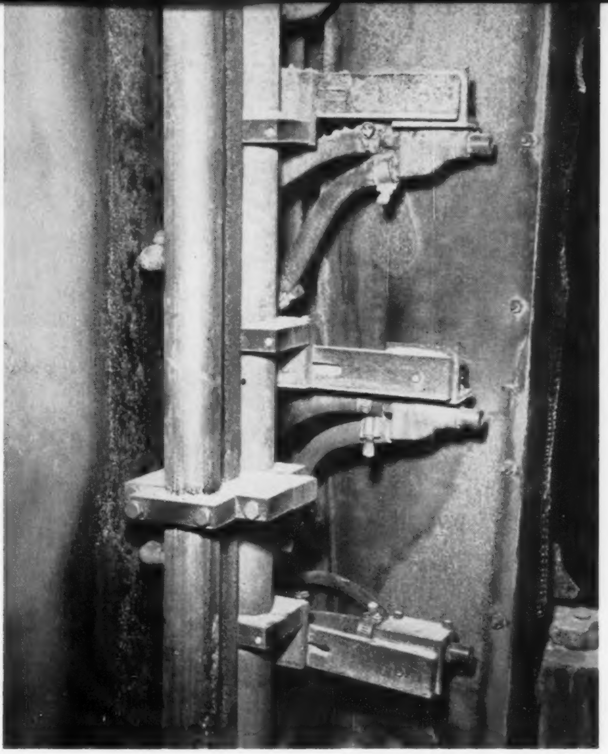


Fig. 4. Three of six nozzles which are directed at each side of the part travel up and down on the vertical slide and, simultaneously, rotate back and forth in order to distribute the spray equally across the surfaces being blasted.

Fig. 5. Here, blasting solution is removed from the skin by high-pressure water sprays applied at one of two such rinse stations located 6 feet apart. Following this operation, the wing panel enters the drying section of the machine.

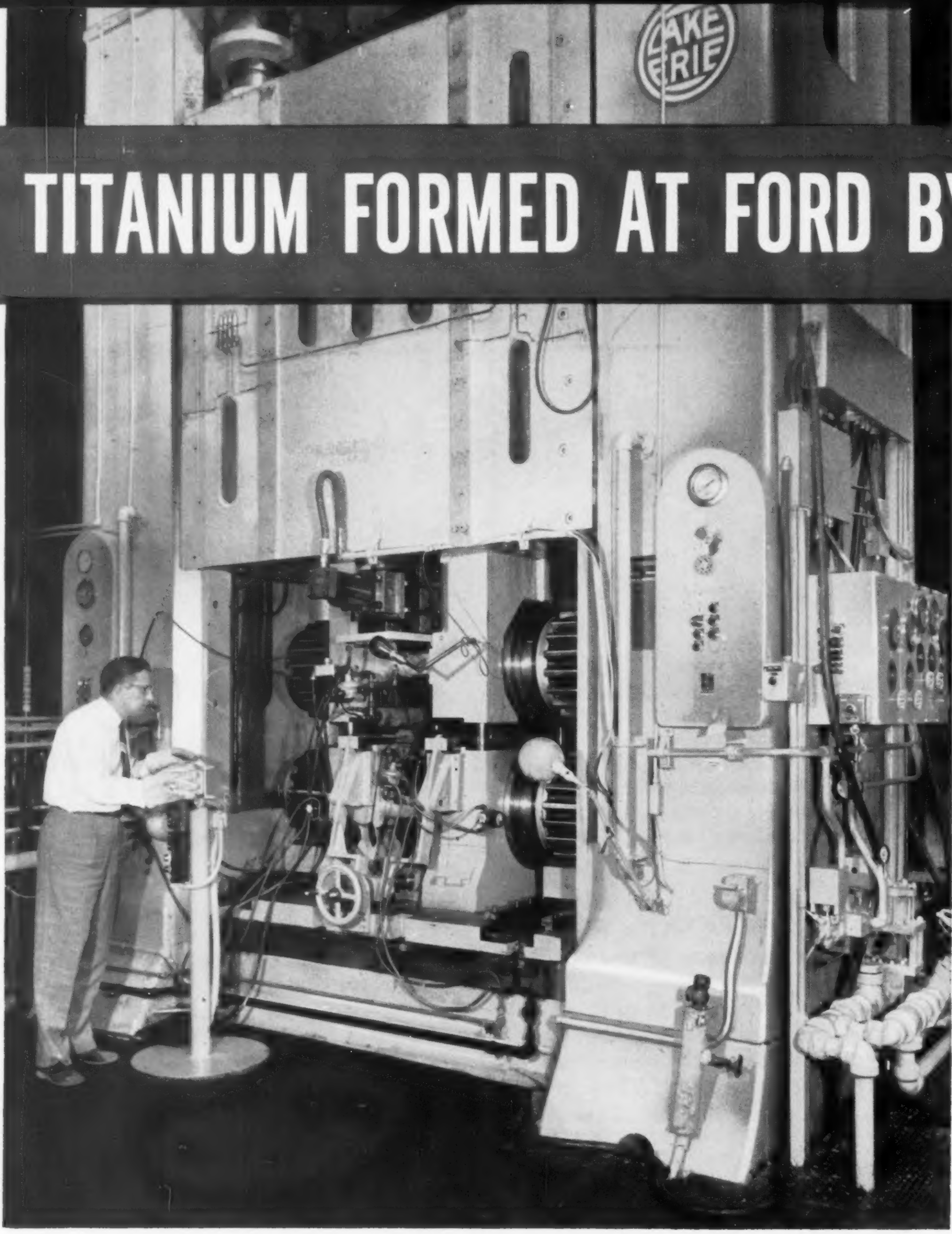
the abrasive from the water, both of which are re-used. Pit installation of settling tanks is illustrated in Fig. 6.

After leaving the rinse, the skin progresses to the drying station. In this final operation, the air is blown through electric heating elements and directed by baffles onto the part. The temperature of the air used to dry the skin is about 100 degrees F.

When the work-pieces emerge from the machine into the unloading station, they are placed in finger racks. In the heading illustration, a wing panel is shown ready for unloading after completion of the deburring and blending process. The entire vapor-blasting operation is completely automatic. The only handling function required of the operator is the manual loading and unloading of the machine.

Fig. 6. Settling tanks are installed in a pit below the machine for recovering abrasive carried away by the rinse water. After separation from the particles, the water is re-used.

TITANIUM FORMED AT FORD BY



ONE important function of the Semi-Production Department at the Aircraft Engine Division of Ford Motor Co., Chicago, Ill., is the development of new or improved techniques for the manufacture of gas-turbine engine components. Proved methods are adopted for the quantity production of J-57 and J-75 turbo-jet engines—being built by Ford under a license agreement with Pratt & Whitney Aircraft Division of United Aircraft Corporation.

Among the unique devices used in the Semi-Production Department are heated folding dies and explosion restrike dies for inlet guide vanes. These vanes are made from 0.040-inch thick, commercially pure titanium. Flat developed blanks, approximately 9 inches wide by 13 inches long, are folded to the required form on the die shown schematically in Fig. 1. The die is mounted in a standard Ford air fixture, provided with floor legs and three pneumatic cylinders. A formed tongue, having the required inside configuration of the inlet guide vane, is raised and lowered by the cylinder on top of the fixture. The side-forming members of the die are advanced and retracted by the other two cylinders.

Electrical resistance elements, made from Nimonic strip material and supplied with power from a standard welding transformer, heat the

HEATING, ROLLING, AND EXPLODING

By CHARLES H. WICK
Managing Editor

side-die sections and platen to a temperature between 800 and 1000 degrees F. The required form on the leading edge of the inlet guide vane is machined into the die platen to a depth of 1/2 inch.

Flat vane blanks are placed on the platen, locating from tabs provided on the stamping. The top air cylinder is actuated to lower the formed tongue. This forces the blank into the formed groove in the platen and folds both sides of the blank upward. Then, air is introduced into the other two cylinders to advance the side-forming die sections and wrap the vane around the tongue. Heat is allowed to soak into the work during a 15- to 20-second dwell period to prevent spring-back of the material after forming.

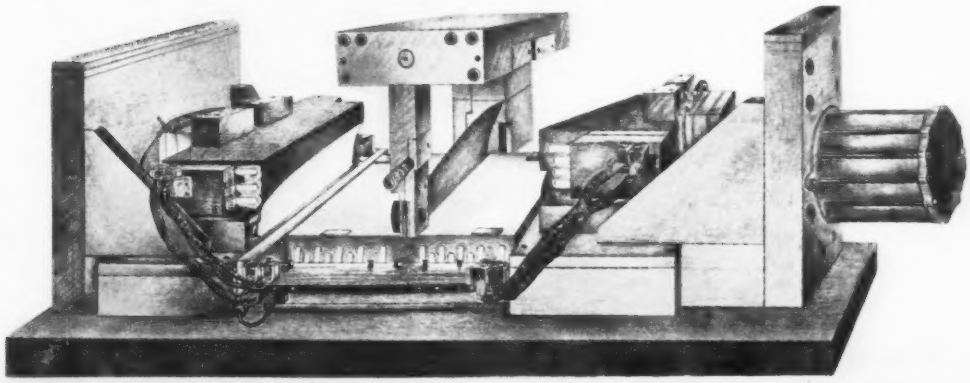
When the side dies and tongue have been retracted, a locking pin is removed from the tongue, and the tongue support arm (mounted on an overhead shaft) is pulled forward. Then, the folded inlet guide vane can be removed from the tongue. Very little pressure is required for this operation. In fact, all three cylinders operate on a standard air line pressure of 90 psi, but the operating valves are only opened enough to move the die sections and tongue.

Folded inlet guide vanes are resistance seam-welded along their trailing edges, and the tabs used for locating and welding purposes are removed. Using a method of explosion restriking introduced by Pratt & Whitney Aircraft, the hollow vanes are finish-formed. This explosion restrike method employs a shotgun shell to expand the metal to final form in the die shown disassembled in Fig. 2. This operation is also performed in a standard air fixture (similar to the one used for vane folding), with the punch and die members again heated to about 900 degrees F. by means of Nimonic resistance elements passing through holes in the die members.

The folded and welded vane is located in the lower die member (left), having the required airfoil configuration machined in its surface. The punch, machined to the contour on the opposite side of the vane, is lowered into place, and the assembly is allowed to soak for thirty to forty seconds to allow the titanium to reach temperature. Full air line pressure is applied to the 3-inch diameter piston to develop 7 tons pressure.

Then, an 8-gage shotgun shell (with shot removed, and calibrated at 10,000 psi for this particular size vane) is inserted in the back face

Fig. 1. Drawing of electrical resistance heated die in which inlet guide vanes of 0.040-inch thick, commercially pure titanium are formed from flat blanks.



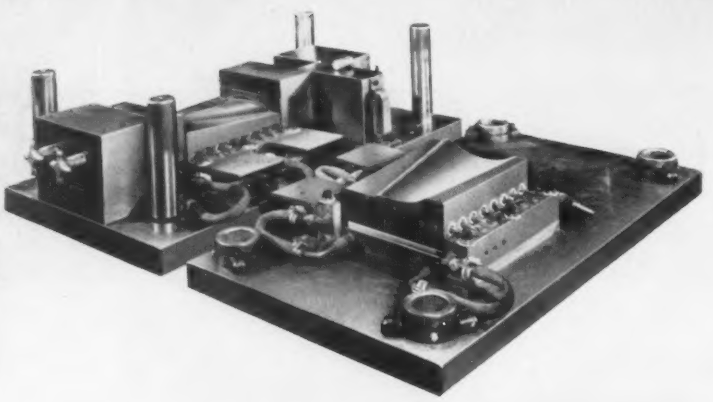


Fig. 2. Explosion restrike die for final forming (from inside) of folded and welded inlet guide vanes. The shotgun shell employed can be seen on firing chamber at top center.

of a sliding-block firing chamber. Water is circulated through the block to keep the shell cool before firing, as well as through the members surrounding the insulated die blocks. The chamber is then slid into place between blocks, and a string is pulled, Fig. 3, to trip the firing pin of a spring-loaded trigger mechanism. Gas pressure escaping from the firing chamber through an airfoil shaped opening in one face of the die bulges the titanium outward to the required shape.

As seen in Fig. 3, the operator wears ear protectors to deaden the sound of the explosion. Since this illustration was taken, a box that fits over the air press is used to isolate the noise. In production, it is proposed to place this cartridge-actuated die in a 50-ton hydraulic press.

A novel method developed by the Semi-Production Department for producing compressor blades is considered of major importance because it is adaptable to mass production on existing presses. With this technique, heated upset blanks are roll-forged to produce the desired airfoil contour on a modified Lake Erie 1500-ton, vertical hydraulic press seen in the heading illustration and Fig. 4.

Ideal grain flow is produced, particularly in the highly stressed areas of the blades. Also, considerable savings in costly material are realized, since the airfoil contour is finished to print specifications in rolling, and no further machining is required except on the root. Previously, forged compressor blades had to be contour-machined all over, and then ground and polished. At present, compressor blades of Rem-Cru AT-110 titanium and AMS 673 corrosion- and heat-resistant steel are being rolled in this way. It is expected that production rates of 150 to 200 per hour will be possible; the exact rate depending on the size of the blades, the material being rolled, and the number of passes required.

Blade forming is accomplished by passing the heated upset blank between two die rolls which are mounted, together with the roll driving gears, on horizontal axes in the die area of the triple-action hydraulic press. A duplicate set of four spur gears (two die roll drivers and two idlers), having a pitch diameter of 19.00 inches and a diametral pitch of 1, is provided on each side of the die rolls. The two gears for driving the lower die roll, as well as the two drive gears for the

Fig. 3. Firing pin of spring-loaded trigger mechanism is actuated by pulling string. The operator wears ear protectors to deaden the sound of the explosion.

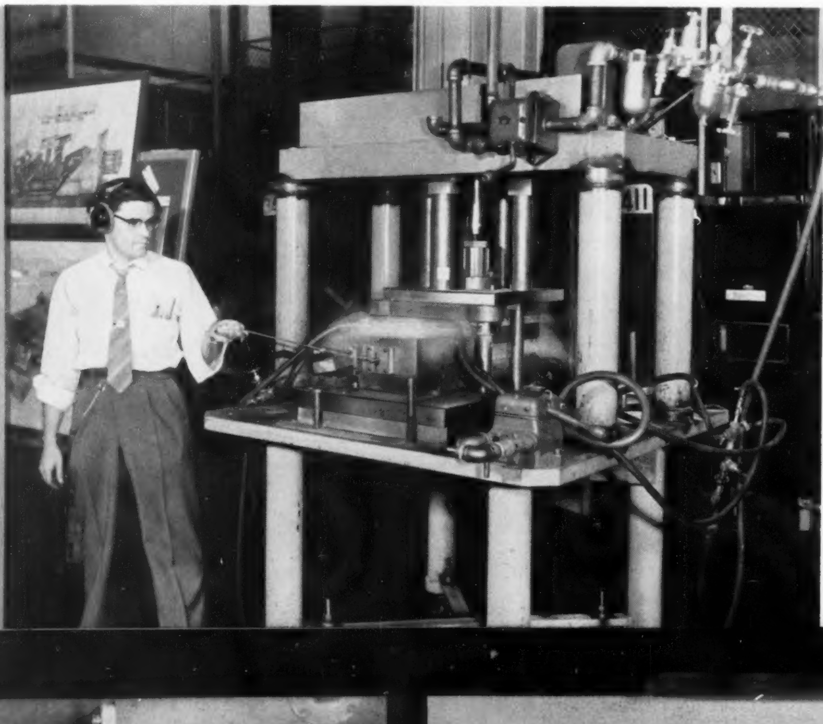


Fig. 4. Front view of 1500-ton, triple-action hydraulic press used to roll steel and titanium compressor blades from heated upset blanks at rates up to 200 per hour.

upper roll, can be seen in Fig. 4, while the two intermediate idler gears on each side of the rolls are visible from the back of the press, Fig. 5.

Each lower drive gear is rotated by a 10-inch wide, reciprocating gear rack that is mounted on the press bed and powered by a 115-ton, 12-inch diameter by 16-inch stroke hydraulic cylinder. Oil under a pressure of 2000 psi is supplied to the two rack-actuating hydraulic cylinders from the die-cushion cylinder in the base of the press. Power from the lower die roll drive gears is transmitted through the idler gears to the upper drive gears.

Linkage provided between meshing gears in each set maintains a fixed center distance between each pair of adjoining gears. While the axes of the lower drive gears are fixed, the axes of the idler gears are moved to the front or back of the press as the upper drive gears (attached to the press inner ram) are raised or lowered. The idler gears also move up and down (one-half the distance of the upper drive gear) as the positions of the upper drive gears are changed.

A total of 1500 tons pressure, taken from the upper ram cylinders of the hydraulic press, is used for the initial impression of the heated compressor blade blanks, and to keep the upper die roll axis in a fixed position during rolling. Downward movement of the press ram and upper die roll is positively controlled by four stop wedges, two at the front and two at the back of the press. If more than one pass is required to complete the roll-forming of the blade, the opening between die rolls is reduced by rotating a graduated handwheel connected to the four stop wedges.

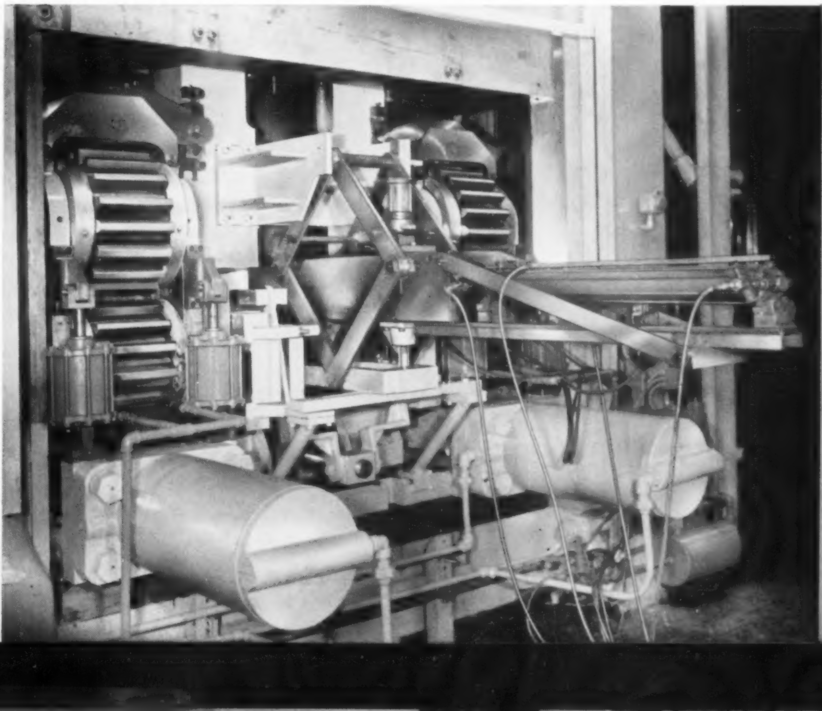


Fig. 5. Rear view of press seen in heading illustration and Fig. 4 shows the two large hydraulic cylinders for reciprocating the racks used to rotate the die rolls.

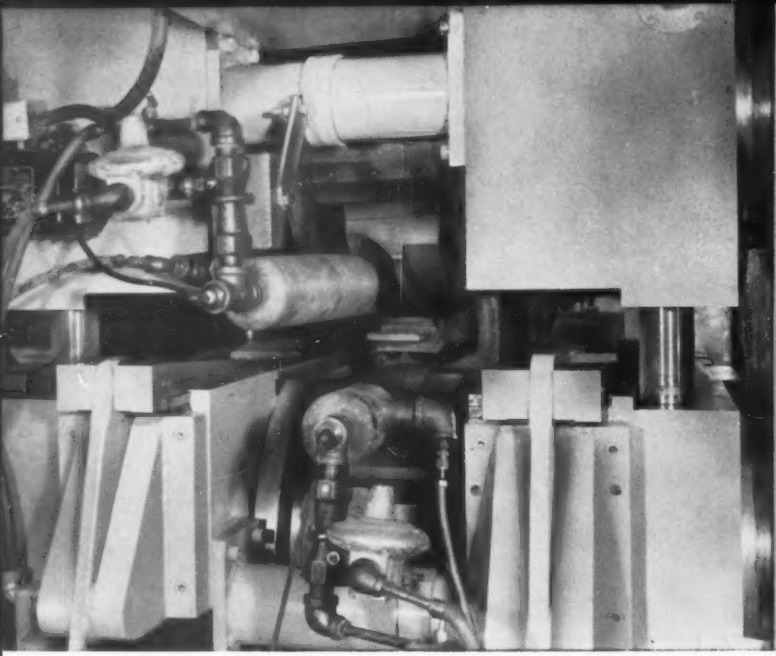


Fig. 6. Gas flames are used to heat blade form inserts on die rolls to a temperature between 900 and 1000 degrees F., prior to the rolling of compressor blades.

The compressor blade blank is gripped in fingers on the end of a feed arm that is reciprocated between the die rolls by a 3-inch diameter by 34-inch stroke air cylinder mounted on the rear of the press (Fig. 5). Prior to rolling, the die roll inserts are heated to a temperature of about 950 degrees F. by means of gas burners, as seen in Fig. 6. The blade form inserts can be quickly removed from the die rolls by simply loosening socket-head cap screws. The adjustable stop wedges can be seen on either side of the die rolls in this illustration.

Developed blanks for producing compressor blades are sheared from strip stock, heated to approximately 1200 degrees F. on one end, and upset to form the root sections. The upset blank is clamped in the feed-arm fingers of the rolling press and fed into an induction heating coil, seen at the right in Fig. 7. Here, the blank is heated to about 1400 degrees F. for optimum rolling conditions.

With the die roll inserts preheated, and the upset blank raised to the proper temperature, the cycle-starting button is depressed. This actuates the feed-arm air cylinder, which retracts the hot blank into position for rolling. As the blank reaches rolling position, the feed-arm trips a limit switch to set the press in motion. The press ram descends until the stop wedges are contacted, causing the die roll inserts to form the initial contour. As the pressure builds up on the ram, the two rack cylinders are actuated to transmit rotary motion to the die rolls.

The feed-arm retracts the blank toward the rear of the press as the die inserts roll the airfoil contour. Upon completion of the blade-rolling cycle, the press ram automatically rises to open the die inserts, and the feed-arm returns to its

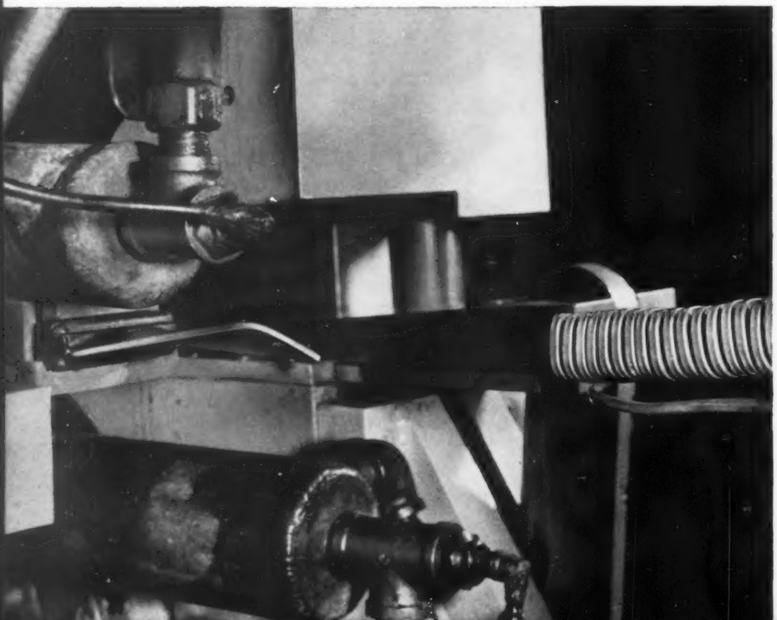


Fig. 7. Compressor blade blank, clamped between fingers of feed-arm seen at left, is advanced into induction coil (right) for heating to 1400 degrees F. prior to rolling.

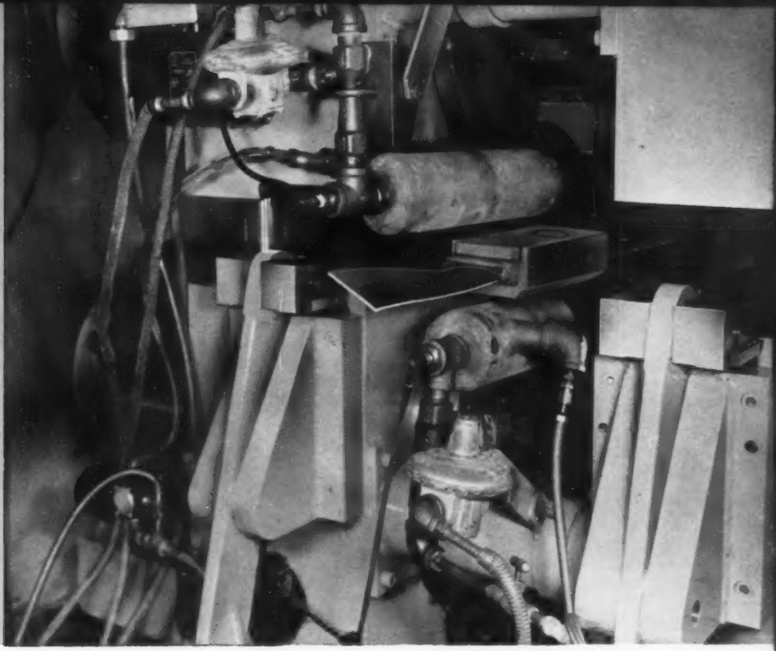


Fig. 8. Feed-arm returns completed blade to front of press for unloading after rolling cycle. If second pass is required, blade is reheated and cycle repeated.

starting position, Fig. 8, for unloading the completed blade from the front of the press. Simultaneously, the racks are retracted to reverse the rotation of the die rolls to their starting position. Longer and thicker compressor blades requiring a second pass are reheated, and the cycle is repeated with the stop wedges adjusted to permit more travel of the ram.

Die inserts for rolling of compressor blades are made from a heat- and abrasion-resistant T-15 grade of high-speed steel containing 13 per cent tungsten, 4 1/4 per cent chromium, 5 per cent vanadium, and 5 per cent cobalt. After hardening, the inserts are drawn back to a hardness of 50 Rockwell C to prevent brittleness. This is necessary because of the chilling effect of the hot work on the cooler die. Asbestos insulation is provided between the rolls and die inserts to prevent the loss of heat to the rolls. No lubrication of the die inserts is used at present, but some type of coating may be necessary for the production of certain titanium-alloy blades to prevent hydrogen embrittlement.

The curved die inserts are made from linear two-dimensional masters on a Keller automatic, tracer-controlled milling machine, Fig. 9, by means of an ingenious attachment designed by engineers of the Semi-Production Department. The attachment fits on the upper and lower spindles of the three-spindle Keller machine, while the die insert to be cut is held in a fixture keyed to a pivoting shaft in the attachment.

A gear sector, also secured to this same shaft, meshes with a rack secured to the attachment box-frame, which also carries the master. Thus, when the stylus is traversed over the master, the rack-and-gear arrangement transfers linear to rotary motion, and swings the insert through the required circular path. The cutter, mounted on the center spindle of the machine, remains perpendicular to the surface being machined.

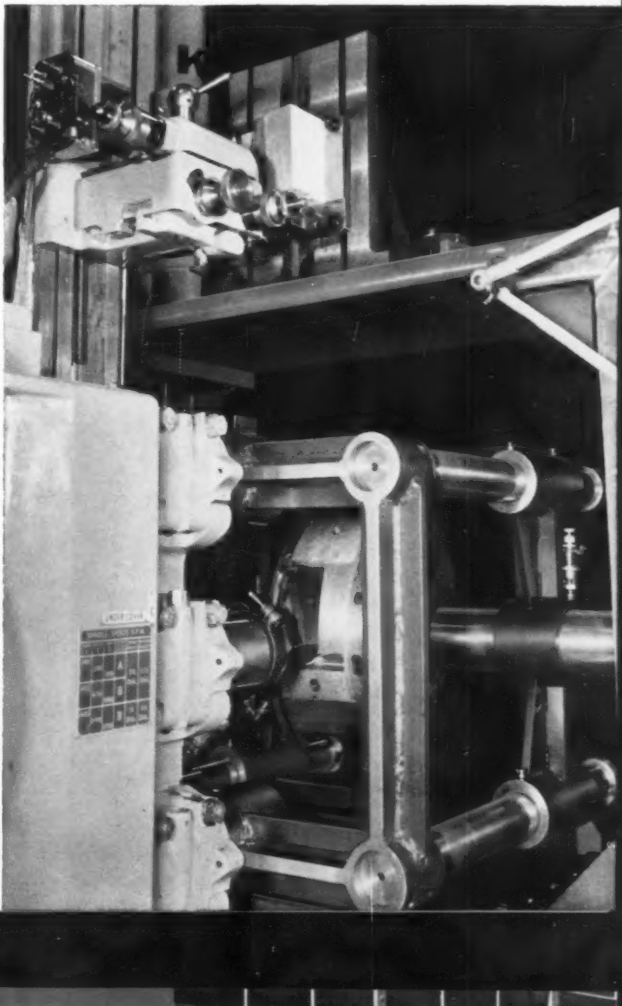


Fig. 9. Special fixture mounted on a three-spindle, tracer-controlled milling machine for cutting curved die inserts from two-dimensional masters.

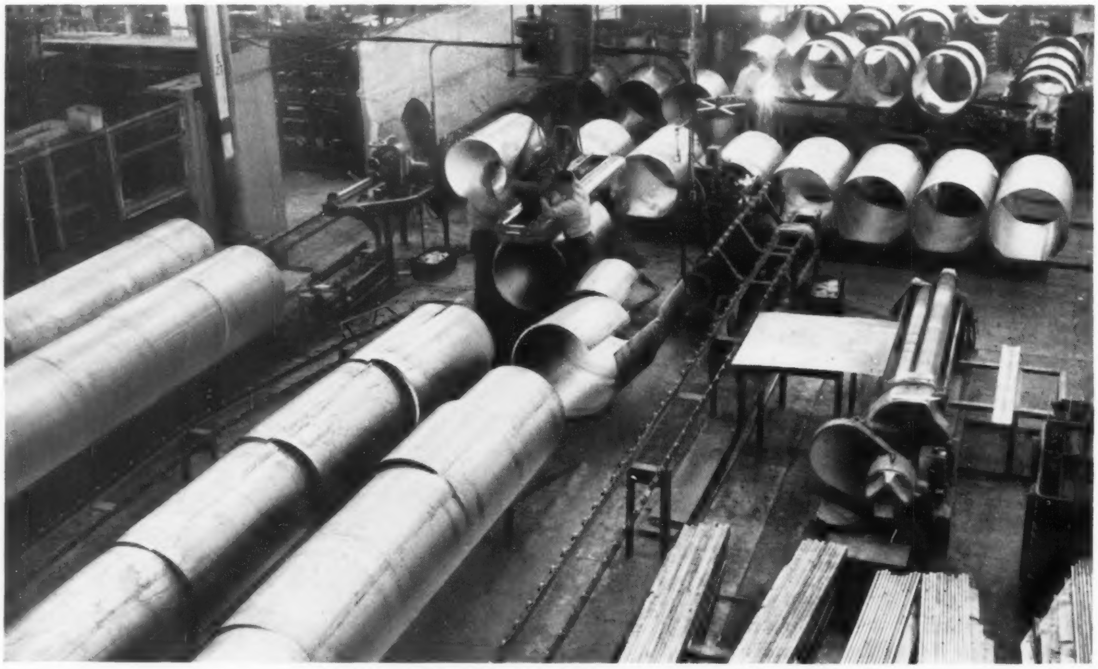
BUILDING CONTAINERS FOR NIKE MISSILES

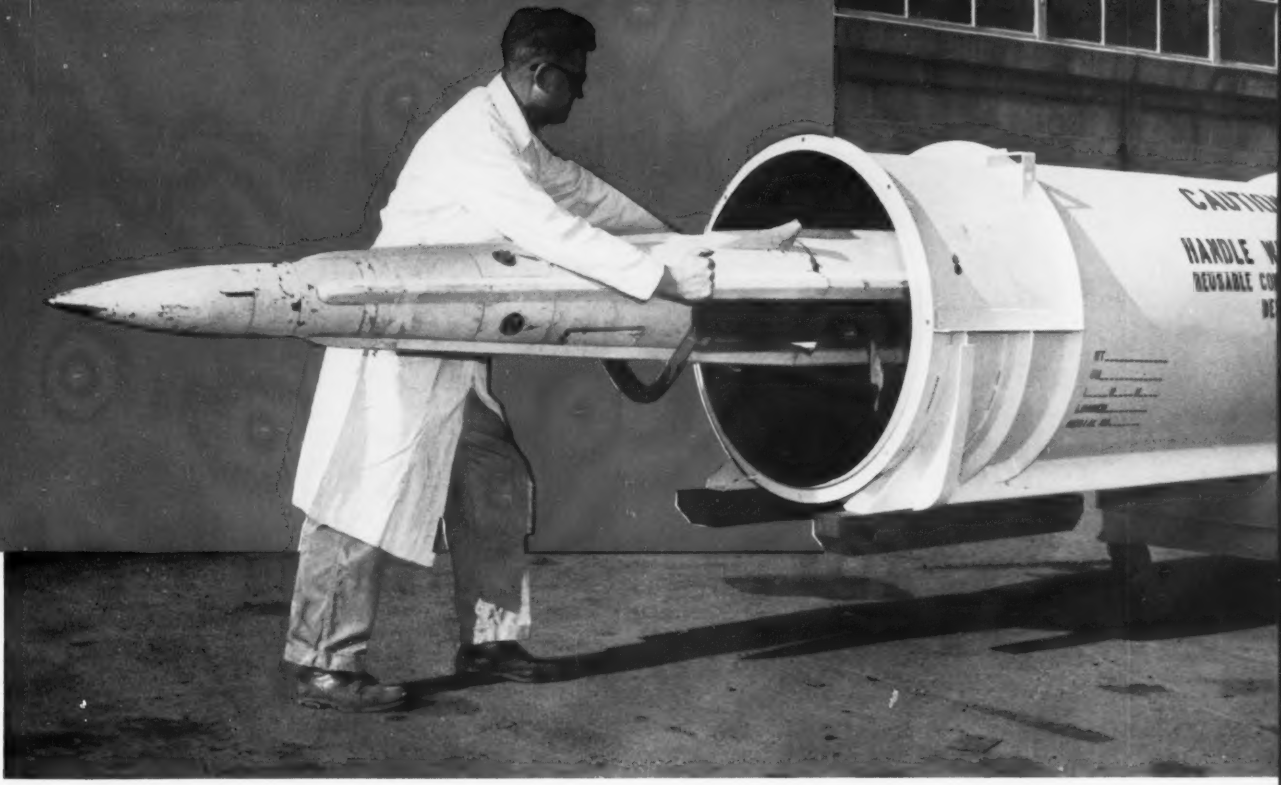
By CHARLES O. HERB, Editor

ONE of the most important defensive implements of warfare developed in recent years by the Ordnance Corps of the United States Army is the Nike-Ajax anti-aircraft missile. Bases for protecting strategic points by means of these missiles in case of a national emergency are being established both at home and abroad. Missiles supplied to these bases must be guarded against corrosion or other deterioration of the war-head and the remaining components.

To provide this protection, each Nike-Ajax missile is sealed in large, airtight, waterproof containers. While in use, these containers have an internal air pressure that is maintained at from 5 to 10 psi. This air pressure prevents outside air or moisture from leaking into the container at any point. Provision is also made on the container

Fig. 1. General view of the department fabricating Nike-Ajax containers. Steel sheets are here rolled into cylinders and then welded into complete containers.





to enable periodic checking of the internal air pressure.

Another purpose of the container is to prevent damage to any Nike part while the missile is in transportation. Each container, therefore, consists essentially of a long, large-diameter cylinder that is fitted at each end with a rubber-gasket sealed head. Internally, there are rubber shock absorbers and rubber-mounted supports that are welded to the cylinder. There is also a track of structural steel members to facilitate sliding the Nike in and out of a cylinder. Externally, the containers are provided with reinforced rings and longitudinal stiffeners. Also, a flange is attached to each end for sealing purposes. When assembled, a heavy rubber gasket is placed between each of these flanges and the head that is bolted to it.

The John Bean Division of the Food Machinery and Chemical Corporation, San Jose, Calif., has been fabricating Nike-Ajax containers for over two years. Most of the work consists of welding, as there are approximately 4000 inches of weld on each container. These containers are 34 inches in diameter and over 20 feet long. Their bodies are constructed of No. 14 gage hot-rolled mild steel.

Each container is fabricated from five sections that are rolled into cylindrical shape from trimmed flat sheets by the equipment seen at the right in Fig. 1. They are immediately transferred to the automatic Unionmelt welding machine seen in Fig. 2 for welding the longitudinal seam. The sections are then crimped on one or both ends to permit telescoping the ends of different sections in assembly.

Next, shock-absorber mounts are carefully located within the sections by using a fixture, and the mounts are attached by applying Lincoln arc-welding equipment. The sections are then delivered to cradle type fixtures such as seen in Fig. 3 for assembling and squeezing together to obtain the desired over-all length. The sections are located radially by entering cam-operated dowels into holes previously pierced in the circumferential rings.

After the sections have been located radially, the assembler uses the long crank handle to force a cross-member against one end of the container to push three sections into one another. Arc-welding operations such as illustrated in Fig. 4 are performed with the assembly in other cradle rotating fixtures. Later, the sections are taken to a fixture similar to the one in Fig. 3 where the remaining two sections are added to the assembly.

The formed angle-iron "gaskets" on the ends are welded completely around the containers and along both contacting edges of the angle-irons. The gasket rings are attached by Unionmelt welding. The reinforcing rings are alternately arc-welded on opposite sides, the entire welding

Fig. 2. Automatic Unionmelt welding machine employed for producing longitudinal seam welds in Nike container sections.

bead being equal to the circumference of the container. The container is fixture-welded to its base and is then moved to rolling fixtures to complete the required detail welding. After welding, the containers are sand-blasted and then put through water and pressure tests. Upon completion of the pressure test, the containers travel on tracks through the cleaning, painting, assembling, and stenciling operations.

In forming structural pieces for the tracks, use is made of the Cincinnati shear shown in Fig. 5 and the Cincinnati press brake shown in Fig. 6. Typical parts formed on the brake are seen in the right foreground. They are formed from 3/16-inch, hot-rolled plates.

The press brake in Fig. 7 is used for simultaneously punching the holes on opposite sides of the reinforcing rings that are used for locating purposes in assembly of the containers, as already described. Use is made of a work fixture designed for easy locating and clamping.

After all welds (both internal and external) have been sand-blasted, the containers are subjected to the water test illustrated in Fig. 8, the heads having been assembled. Air at a pressure of 20 psi is forced into the container prior to the test, so that improper welds will be indicated by air bubbles in the water.

Afterward, Army inspectors perform a very stringent twenty-four-hour test during which there can be only a very slight drop of air pressure. An allowance is calculated for barometric and temperature changes.

When the containers have passed these tests, the heads are removed, and both the containers and the heads are subjected to cleaning and phosphatizing operations. An Oakite No. 21 solution is used in the cleaning step. Both the con-

Fig. 3. Cradle type fixture used for assembling the various container sections in proper radial and longitudinal positions.

Fig. 4. In a typical arc-welding operation welder is attaching one of the angle-iron rings against which a rubber seal is clamped when the head is installed.

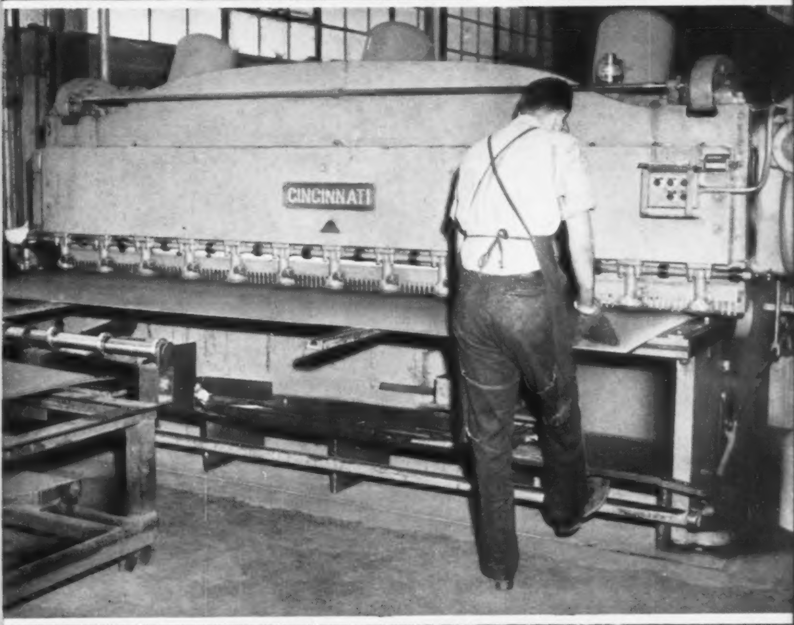


Fig. 5. Steel sheets are cut to the proper width on this shear in preparation for forming structural members for the Nike containers.

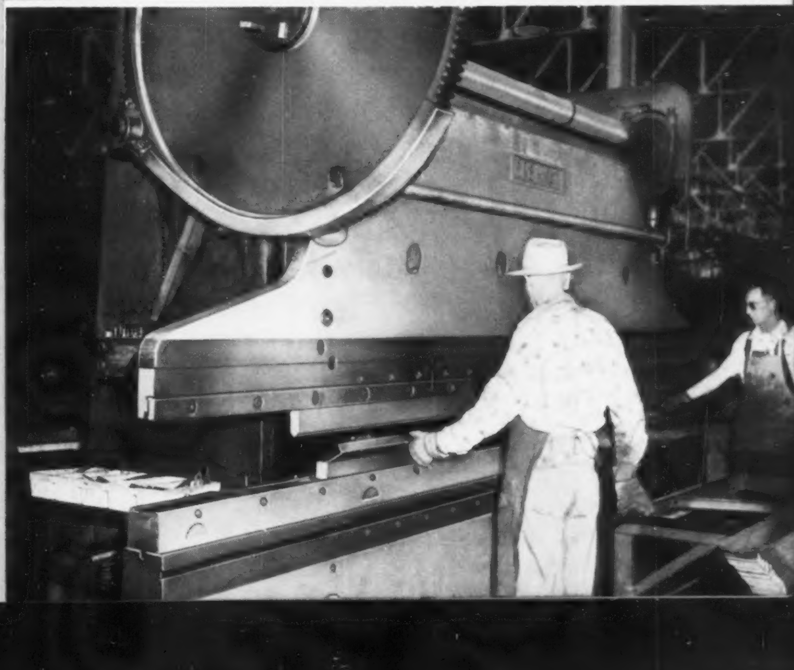


Fig. 6. Press brake which is used to form structural stiffeners that are subsequently welded to the Nike containers. Typical parts formed on this machine are seen at lower right.

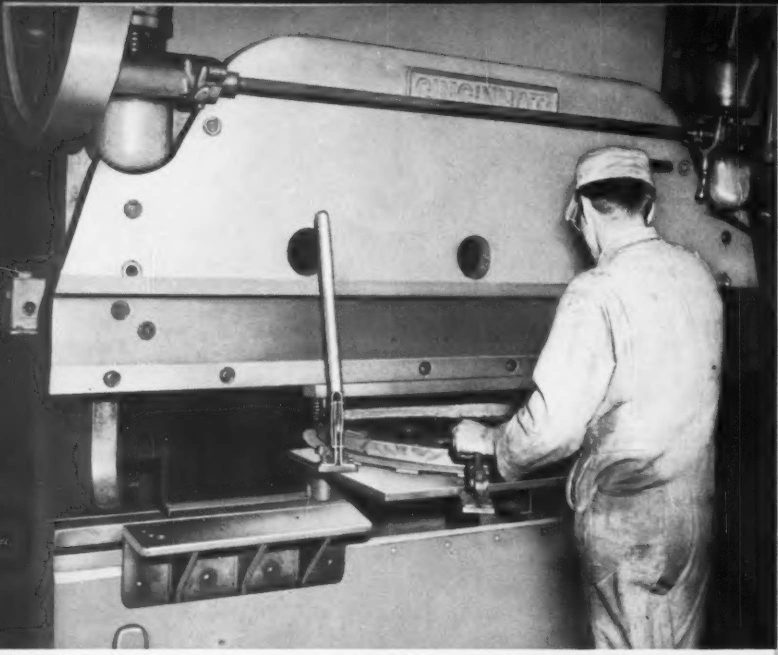


Fig. 7. Another press-brake operation in which holes are pierced in rings that serve to strengthen the container circumferentially.

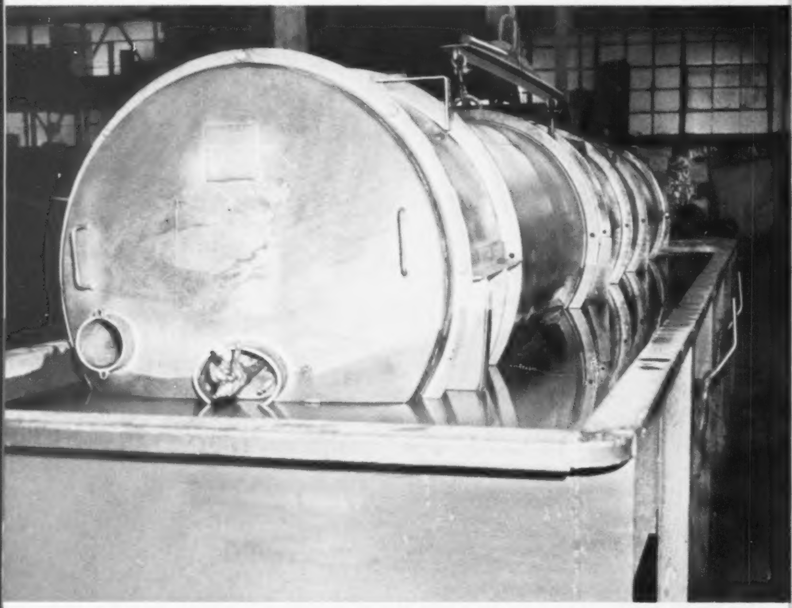


Fig. 8. After completion of all welds, each container is subjected to a water test to make certain that it has been made completely airtight.

Fig. 9. A zinc-chromate primer is applied all over the Nike-Ajax containers, and then they are spray-painted olive-drab internally and white on the external surfaces.

tainers and heads go through a drying furnace prior to painting.

The containers are spray-painted an olive-drab color internally and white externally; the latter step in the process is shown in Fig. 9. The first step in the painting process, however, is to apply a zinc-chromate primer all over. Cleaning, drying, and painting of the heads are performed with the heads moving continuously on an overhead conveyor. The final operations are to assemble a carriage for convenient loading and unloading of the Nike missiles, reassemble the heads, and stencil essential information on the containers in black paint.

Tape-Controlled Drilling of Holes Around Circles

BOTH milling and drilling operations are performed on a Gorton vertical milling machine equipped with a Micro-Positioner table in the Torrance plant of the El Segundo, Calif., division of the Douglas Aircraft Co., Inc. The illustration shows this machine being used for the accurate drilling of ten holes in a cross-feed fitting for fuel tanks, an operation that must be duplicated many times in producing considerable quantities of these fittings.

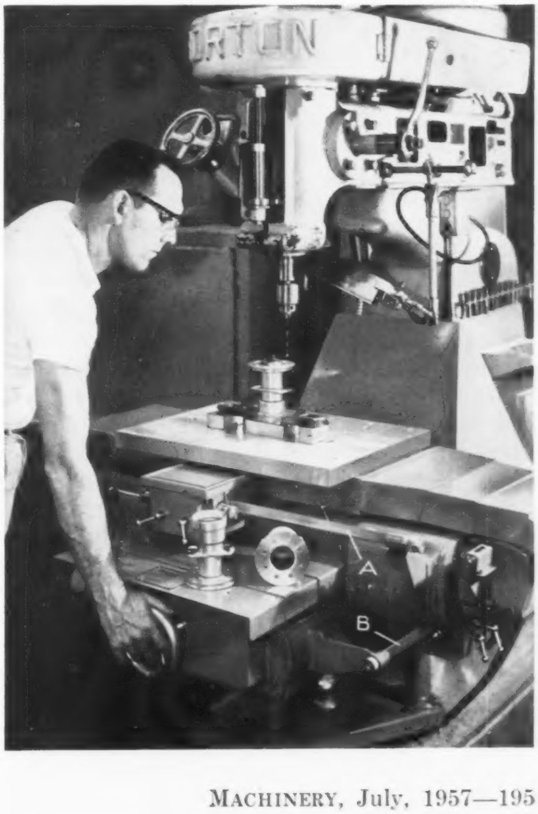
Eight of the holes, having diameters of 0.300 to 0.316 inch, are equally spaced around a 2.750-inch diameter circle on the end flange. The center-to-center distance between the holes must be correct within 0.010 inch, and the tolerance on the location of the center line for the initial hole, within one-half degree of arc. Two holes, 0.246 to 0.260 inch in diameter, are also drilled through ears located near the middle of the part. For this drilling operation, the part must be set up a second time on the machine table with the externally threaded end uppermost. The part is made from aluminum bar stock.

The work is correctly positioned for drilling the successive holes by longitudinal and transverse movements of the Micro-Positioner table under the control of two steel tapes. One tape spans across the front of the table, as seen at *A*, for controlling the longitudinal table movements, and the second tape extends from the front to the back of the table, as indicated at *B*, for controlling the transverse settings of the work.

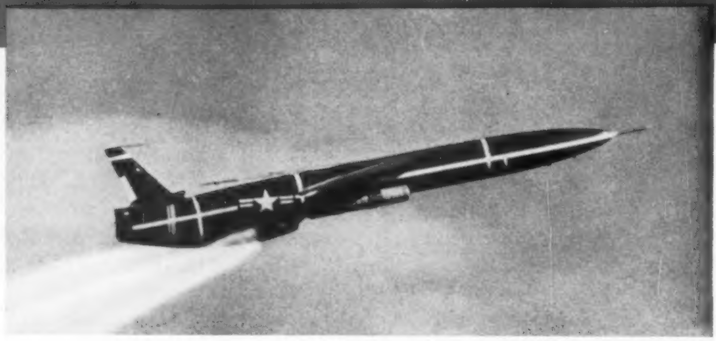
Indentations on the tape, which are made at the time that the job is set up for the first time, act on a sensing mechanism to stop the table movements each time the work is located in a desired position. The table movements are automatically governed by an electric combination clutch and brake, which starts and stops lead-screws to impart the longitudinal and transverse movements to the table. The indentations are made on the tape with an accurately laid out but undrilled piece, properly located on the table. Two solenoid-actuated pins are employed to indent the tape at each required point. Top and bottom rows of indentations are made on each tape so as to control right- and left-hand movements in the case of tape *A*; in and out movements in the case of tape *B*. All movements of the table are directed from a control panel.

The Micro-Positioner table does away with the necessity of using jigs on production work. The table has a fast traverse of 90 inches per minute and slows down to a feed of 6 inches per minute as each position point is neared.

Vertical milling machine equipped with Micro-Positioner table that facilitates the duplicate drilling or milling of work-pieces.



HOT-STRETCHING ELIMINATES SIX FORMING OPERATIONS



Northrop "Snark" SM-62
Pilotless Guided Missile

By **BARTLEY MALONEY**
Fabrication Tooling Engineer
Northrop Aircraft, Inc.
Hawthorne, Calif.

INTEGRAL heating of aircraft structural shapes as they are being formed on a stretch press has eliminated six out of seven steps involved in conventional stretch-forming of parts at Northrop Aircraft, Inc., Hawthorne, Calif. Moreover, the ten hours of bench work ordinarily required on stretched parts for each hour of machine work are not necessary with parts produced by the new process.

A general view of the stretch press used for this work is shown in Fig. 1. The die is heated by thermostatically controlled, 110-volt electrical cartridges which are set into the die body. The work-piece is heated by a 440-volt resistance heater having terminals that are attached adjacent to the jaw inserts of the press. The electrical current delivered through the part is varied to suit the part thickness. A controlled input from 0 to 50 kw may be maintained as needed. Parts may be heated over a wide range of temperatures up to 1500 degrees F. This temperature range allows for processing all metals now in common use, including titanium.

When the part has reached the desired temperature, it is stretched in the regular manner to an automatically controlled amount of elongation. Equal temperatures are maintained for both the die and the work to prevent cooling of the part upon contact with the die. In other words, a part is heated on the machine prior to the starting of the operation. If the temperature were different for the work and the die, stresses would be built up within the part on the cool side. The high precision of parts formed in this manner is indicated by the fact that a feeler gage only 0.002 inch thick cannot be passed between the part and the die when the finished and trimmed part is replaced against the die.

Parts formed in this manner have no residual stresses such as those set up in cold-forming, and they may be machined after forming without causing the part to "rainbow" or warp. Stretch-forming dies used in the new process are made to the net dimensions of the work rather than under size, as is customary, since no spring-back occurs in the work. In Fig. 2 is shown a stress-free ring that was produced by forming two aluminum T-sections into semicircles and then welding them together. A fringe advantage that accrues with the process is that aluminum in the

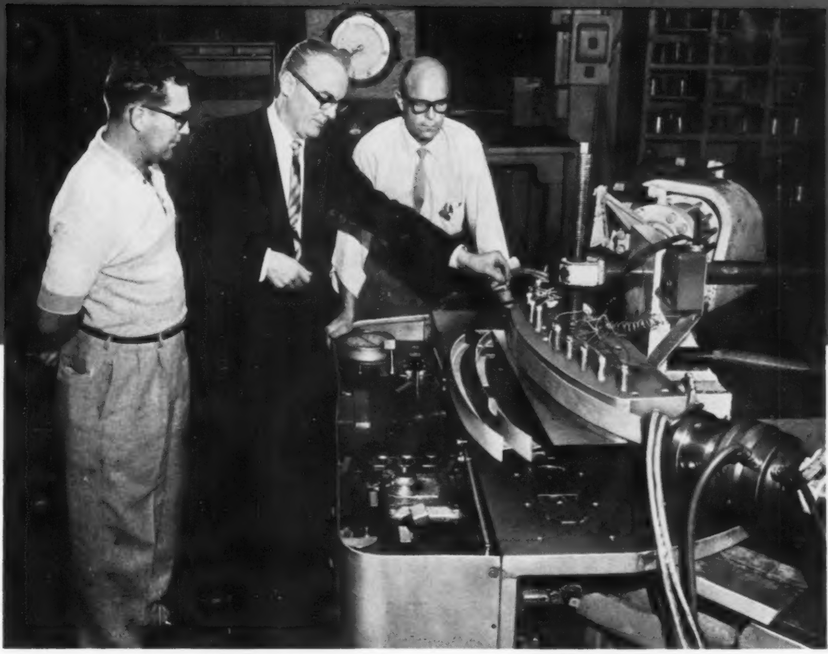


Fig. 1. Stretch-forming press equipped with a thermostatically heated die-block and having provisions for heating the work prior to forming operations, which enables the production of stress-free stretched components.

ST condition can be stretch-formed. This is a definite aid to volume purchasing and simplification of inventories.

The six operations that have been eliminated by stretch-forming parts with the new process include preforming of parts, solution heat-treating, age heat-treating, checking and straightening after aging, hand-forming, and storage in refrigerated boxes while awaiting the stretch-forming operation. This process will be made available to industry through licenses obtained from the Northrop Associated Products Department.

Fig. 2. A stress-free formed ring being held by the author. This ring was produced by welding two hot-stretched semicircular aluminum T-sections together.

"PRESSURE COOKER"

Short-run quantities of magnesium aircraft skins can be formed quickly and economically by taping flat blanks to formed aluminum skins and subjecting the assemblies to a combination of vacuum, pressure, and heat.

By H. F. YOUNG
Production Engineering Manager
Avro Aircraft Ltd., Toronto, Canada

A NOVEL method of forming magnesium-alloy aircraft skins has been developed by Avro Aircraft, utilizing the company's existing autoclave equipment. While magnesium can be formed by the same general methods used for other metals, production is complicated by the need for heating. Furthermore, to achieve consistently good results, the heat must be applied evenly.

The temperature range for forming magnesium alloys generally varies between 300 and 600 degrees F. Certain alloys are readily formable at the lower end of this temperature range on presses and drop hammers. Such operations are relatively fast, since once the blanks are brought up to forming temperature, there is little time lost before the blanks are positioned and the forming operation completed.

With these methods, it is seldom necessary to provide permanent heating facilities within the dies. If long production runs are not required, and the chill is taken from the dies by preheating, satisfactory parts can be produced by simply heating the magnesium blanks. In stretch-wrap forming, however, more time is required since both the form-block and work blank are heated.

To solve the problem of economical, small production runs, Avro engineers tried forming in an autoclave—which has built-in heat and pressure supply—with surprisingly good results. The autoclave, or "pressure cooker," was purchased originally for metal-to-metal bonding, which is used

MOLDS MAGNESIUM SKINS

extensively in building the company's supersonic Avro Arrow airplane. The autoclave, 7 feet in diameter by 25 feet long, is capable of developing pressures up to 200 psi, and a maximum temperature of 450 degrees F. Present metal-bonding practice requires a pressure of only 100 psi, and a temperature of 350 degrees F.

In forming magnesium-alloy aircraft skins, it is first necessary to make an aluminum master. Such masters are formed from 1/8-inch thick 24S-O aluminum sheets by rolling or pressing to the required contour. The contour is carefully checked by means of a plaster model or templates. Special care is taken to insure that the surfaces of the formed aluminum master are free from imperfections, as even minor faults will be reproduced on the magnesium skin.

A flat magnesium sheet is placed on the formed aluminum part and secured with masking tape, as seen in Fig. 1. This assembly is wrapped in felt blankets and enclosed in a polyvinyl alcohol bag which has an outlet for a vacuum attachment and thermocouples. The purpose of the felt is to protect the plastic bag from being punctured by the edges or corners of the metal sheets. The bag itself serves to prevent the increasing pressure in the autoclave from getting between the sheets, and thereby offsetting the clamping action of the high-pressure air.

As the air is being exhausted from the sealed plastic bag, Fig. 2, the magnesium sheet is pressed down by hand to conform with the contour of the aluminum master. Holding the materials together during evacuation of the air prevents the felt and plastic from being sucked between the two sheets. With air pressure holding the magnesium to the aluminum form, the thermocouple lead from the plastic bag is attached to a temperature recorder to accurately control both the time and temperature.

The bag, with its contents and thermocouple and vacuum connections, is placed on a work tray and rolled into the autoclave, as seen in the heading illustration. When the door has been

Fig. 1. Initial step in forming magnesium-alloy aircraft skins is to tape a flat magnesium sheet to a formed aluminum master.

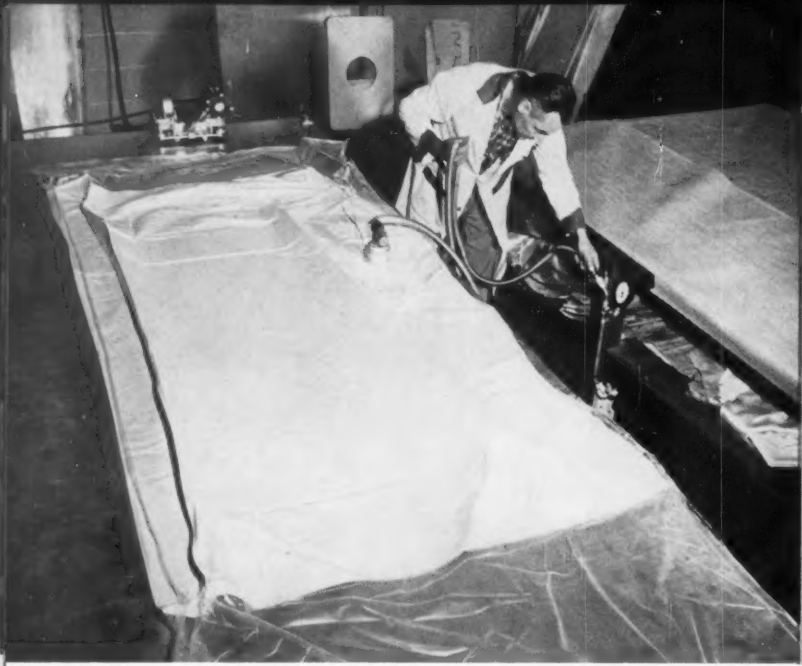


Fig. 2. Vacuum connection is being made to polyvinyl alcohol bag containing magnesium-sheet and aluminum-master assembly that has been wrapped in felt blankets.

closed, air is continuously exhausted from the bag by vacuum pump. Simultaneously, the temperature is raised to 300 degrees F. by means of steam coils in the autoclave, and then to 350 degrees F. with electrical resistance heaters. This heating cycle takes 25 minutes, while the pressure is maintained at 85 psi. Then, the assembly is cooled to about 140 degrees F.

Upon the completion of the curing cycle—requiring approximately 45 minutes—the assembly is removed from the autoclave. The now brittle vinyl bag is stripped off, the vacuum and thermocouple attachments are disconnected, and the felt is removed. A completed magnesium skin and the aluminum form are shown in Fig. 3. The plastic bag is, of course, only good for one forming operation; but the felt can be used several times, and the aluminum master, permanently.

Although autoclave forming of magnesium-alloy skins cannot be considered as a high-production method, it has proved most successful for short-batch requirements. A major advantage of the process is that normal amounts of metal-to-metal bonding work can be accomplished simultaneously in the same autoclave—the pressures and temperatures required are the same.

Avro's production engineering staff anticipates that with suitable future development, it will be possible to perform the process with a heated fixture having the necessary provisions for the application of vacuum, and an air pressure bag to set the magnesium to shape. With such a setup, the autoclave could be used more extensively for bonding.

Fig. 3. Completed magnesium-alloy skin (left) and aluminum master from which it was formed in autoclave. Aluminum master can be re-used.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Drill Jig for Shaft Collars of Various Proportions

By CLIFFORD T. BOWER, London, England

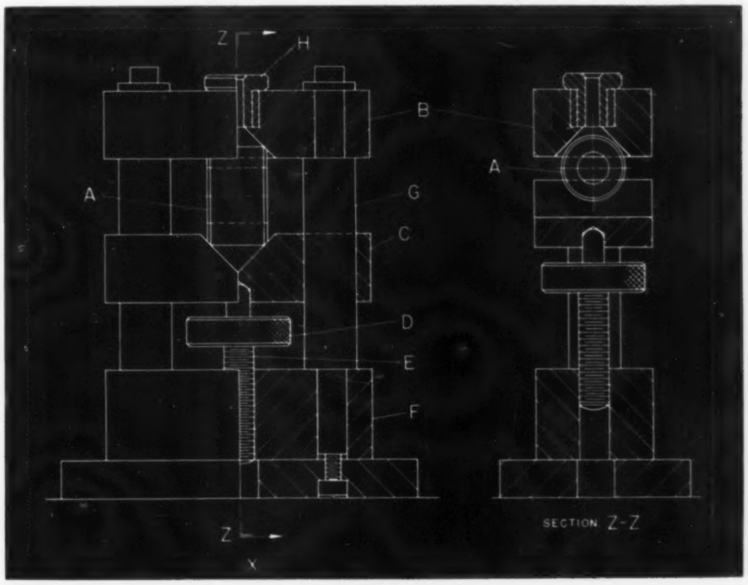
A drill jig that can hold any cylindrical component within a fixed range of outside diameters and widths is here illustrated. Parts are clamped on their outside edges between two plates—one having a conical recess, and the other, a V-groove. The tool was designed for drilling and tapping set-screw holes in several sizes of collars for use on steel shafts.

Instead of locating the work-piece by the bore, each collar *A* is positioned and clamped by means of its outer edges. To provide a better bearing surface, these edges should be given a 45-degree chamfer. A conical recess in the upper jig plate *B* centers each collar automatically. The adjustable lower jig plate *C* could have been provided with a similar conical recess, but the V-block shape was chosen since it resists the turning torque that is produced during the drilling and tapping operations.

In use, a collar is loaded into the jig by rolling it along the V-groove and simultaneously raising this lower jig plate to clamp the piece by turning the knurled knob *D* on the elevating screw *E*. The lower jig plate can be raised rapidly, as screw *E* has a coarse thread and turns freely in the tapped hole in the base *F*. A light clamping pressure is required to hold the work. Two supporting posts *G* for the upper jig plate also act as guides for the lower jig plate.

The half-section view X of the jig shows a large collar in place for drilling, while section Z-Z shows the jig with a small collar in position. As all collars required the same size set-screw, a single slip bushing *H* that is removed during tapping is used for guiding the drill.

This type of drill jig can also be adapted for drilling and tapping components such as spherical knobs.



A number of sizes of shaft collars can be drilled and tapped for set-screws in this drill jig. Fixed, upper jig plate (B) has a conical recess that centers each work-piece.

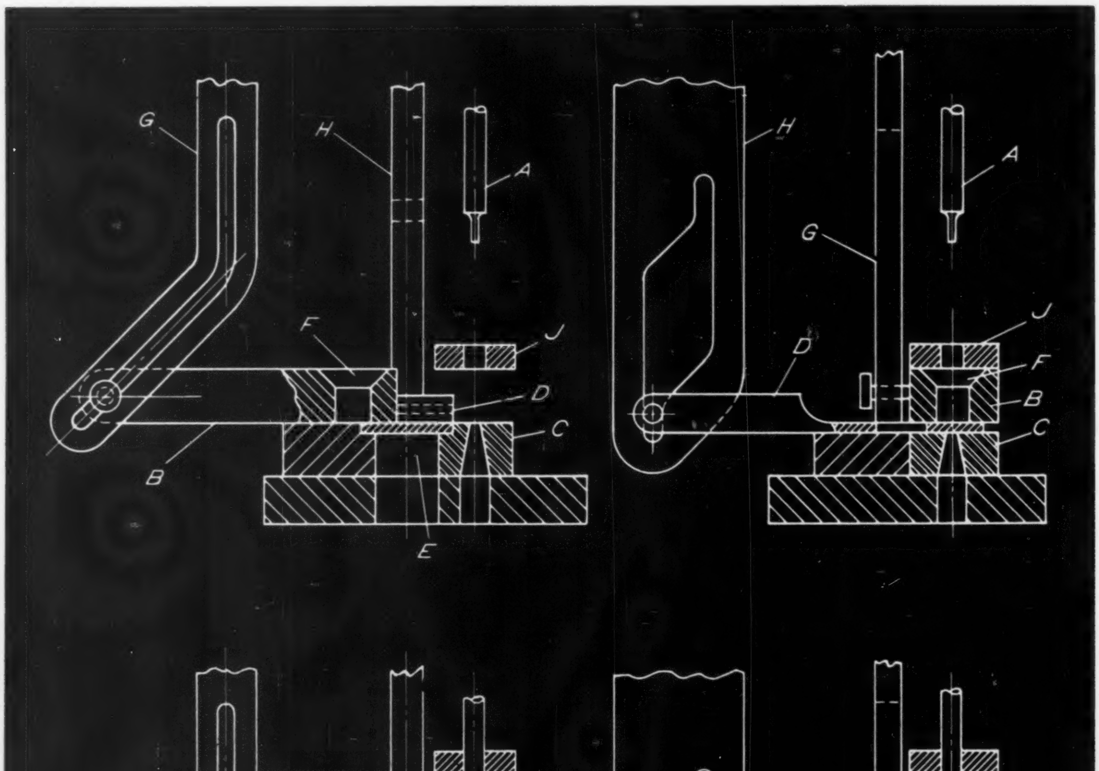
Semi-Automatic Feeding Device for Second-Operation Dies

By Federico Strasser, Santiago, Chile

Second-operation dies employed for piercing, shaving, or trimming often have feed-slides to transport the blank to the work area. The same device also provides a means of removing the finished piece from the die. These slides may be manually operated or cam-operated by means of press-ram action. A simple but efficient cam-operated die-feeding mechanism that provides automatic work-piece ejection is here illustrated.

When the press ram and punch *A* are at the top of their strokes, as seen in the two upper views of the diagram, feed-slide *B* is outside the working area of die *C*. At the same time, an auxiliary slide *D*, mounted at right angles to the feed-slide, covers the work-piece escape hole *E*.

With this arrangement, a blank dropped into the recess *F* in the feed-slide is pushed horizontally by cam *G* into the piercing position and pierced on the down stroke of the ram. Just prior to the actual piercing, cam *H* activates the auxil-



On upward stroke of press ram, feed-slide (B) allows work-piece (not shown) to escape through hole (E) previously uncovered by auxiliary slide (D).

iary slide to uncover escape hole *E*. The two lower views show the relative positions of the two slides with the punch fully descended.

On the upward stroke of the press ram, the part is stripped from the punch by stripper *J* and is then carried from the die by the feed-slide. During this movement the work-piece passes over and through the escape hole in the auxiliary slide. A conveniently placed chute or bin receives the finished work. The auxiliary slide returns to its starting position at the end of the upward stroke, thus covering the work-piece escape hole.

Milling Fixture Holds Spindles Vertically

By F. C. Elmo, Dayton, Ohio

To mill two slots across the nose end of small spindles, a fixture was designed to support the work vertically. A drawing of the part is shown in Fig. 1. The slots, 0.040 inch wide, are at right angles to each other. They are cut with an arbor-mounted circular saw. The fixture itself is held on a Hartford Super-Spacer, so that it can be rapidly indexed and the two slots milled in sequence.

It was decided to design the fixture to grip the spindle on its main body area, rather than on the nose, because of the tendency of the nose to collapse as the slots were produced. A cross-section of the fixture appears in Fig. 2.

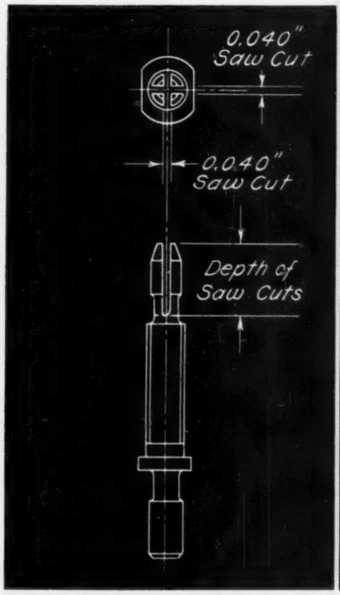
Spring collet *A* is bored internally to receive the spindle. Four splits *B* in the collet, 90 degrees apart, provide the necessary closing flexure and also give the saw access to the surfaces to be cut. Work is loaded into the bottom of the collet, which is first removed from locator *C*.

Spring-loaded plunger *D* thrusts the work upward until its shoulder *E* is against a step in the collet bore. Then clamp *F* locks the plunger in position, and threaded ring *G* is slipped over the collet and engaged with the locator. The inside of the ring and outside of the collet have corresponding tapers. Tightening the ring, by means of hand spokes *H*, compresses the collet, and thus secures the spindle for the milling operation.

* * *

Casting of 32-Inch Diameter Ingots

In the article "Latest Techniques in Extruding Aluminum," published in May Machinery, it was incorrectly stated that Kaiser Aluminum & Chemical Corporation had cast ingots up to 32 inches in diameter under a manufacturing methods development contract awarded by the Air Materiel Command. This method was developed by the corporation's Department of Metallurgical Research under a program of its own.



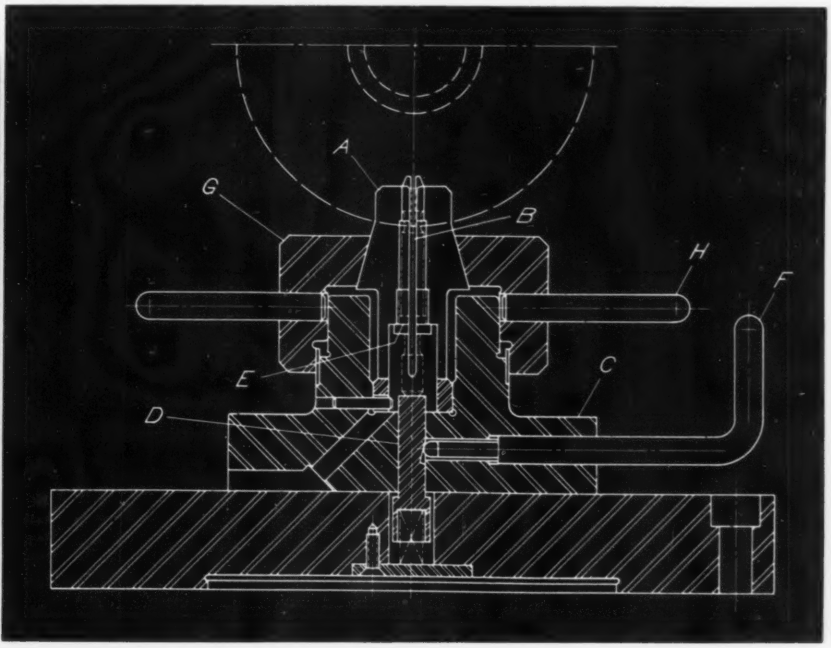
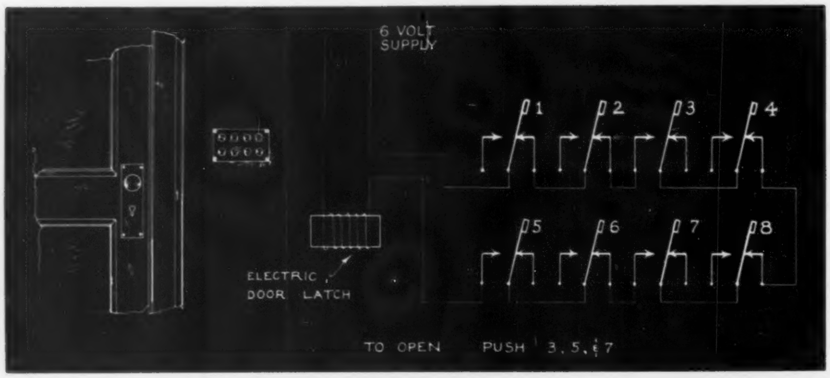


Fig. 1. (Left) Location of the two slots in the nose end of the spindle is here illustrated.
Fig. 2. (Right) Spindle is secured when collet (A) is compressed by turning ring (G).

SHOP KINKS



The eight push-buttons, wired in series, provide 256 possible combinations of operating the latch. Wired as shown, pressing push-buttons 3, 5, and 7 will open door.

Push-Button Combinations Control Door Latches

By Clint McLaughlin, Rockaway Beach, N. Y.

To lock its tool cribs and storerooms, a machine shop devised an interesting push-button system. Problems of keeping track of keys for doors and changing locks when keys were lost have been eliminated with this system.

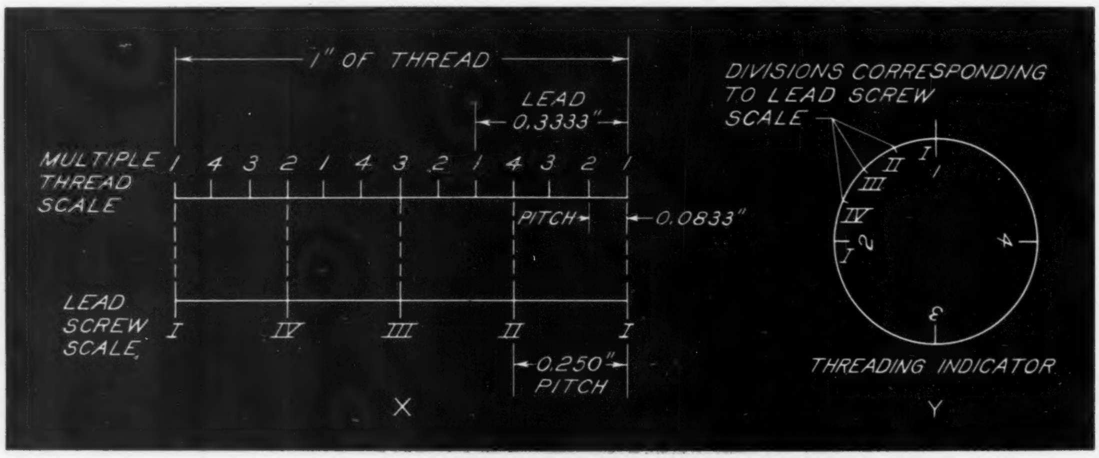
The accompanying illustration shows how the new system works. Door hardware includes the usual electric door latch. Near the jamb is a panel of eight push-buttons, wired in series to the latch. Buttons are the type that can be connected in either a normally open or a normally closed position. To open the door, the buttons which are wired normally open must be pushed, while the buttons which are wired normally closed must not be pushed.

In the drawing, buttons 3, 5, and 7 must be pushed. There are 256 combinations possible with eight buttons, but only one of them will open the door. To change the combination that will open the door, it is only necessary to switch a few wires.

Simple Method for Cutting a Quadruple Thread

By Cecil H. Smith, Galt, Ontario, Canada

A quadruple thread with a 1/3-inch lead and a 1/12-inch pitch can be cut in several ways. Finding the easiest method presents a problem



Scale diagram that correlates quadruple thread and lathe lead-screw for indexing of the tool by the threading indicator.

that has an interesting solution when the lathe used has a lead-screw with four threads per inch. The method does not involve any repositioning of the lead-screw gears, the work, or the compound rest.

As an aid to visualizing the conditions of the problem, two parallel lines of any convenient length, as shown in view X of the accompanying illustration, were drawn on a piece of paper. Each line represents 1 inch of thread. The top scale symbolizes the quadruple thread and is divided into twelve equal parts. Every one-pitch division is given a number, one to four, according to the particular start it indicates. The bottom line, representing the lathe lead-screw, is divided into four equal parts, I to IV. It is important to note that each of the four starts has one position on the multiple-thread scale that lies opposite a one-pitch division on the lead-screw scale. Under these conditions, the threading indicator may be used for indexing the tool when cutting a multiple thread.

One division on the threading indicator dial also equals 1 inch of lead-screw travel. On this particular lathe, the half-nut can be engaged at each quarter-division. Thus, if a division on the threading dial, shown in view Y, is subdivided in the same manner as the bottom or lead-screw scale, the quadruple thread can be cut by engaging the half-nut progressively at each of these quarter-divisions. Number 1 start will be cut at subdivision I, but number 2 start will be cut at subdivision IV. This is indicated by the two scales. Multiple threads with other pitch and lead combinations may also be cut by this method.

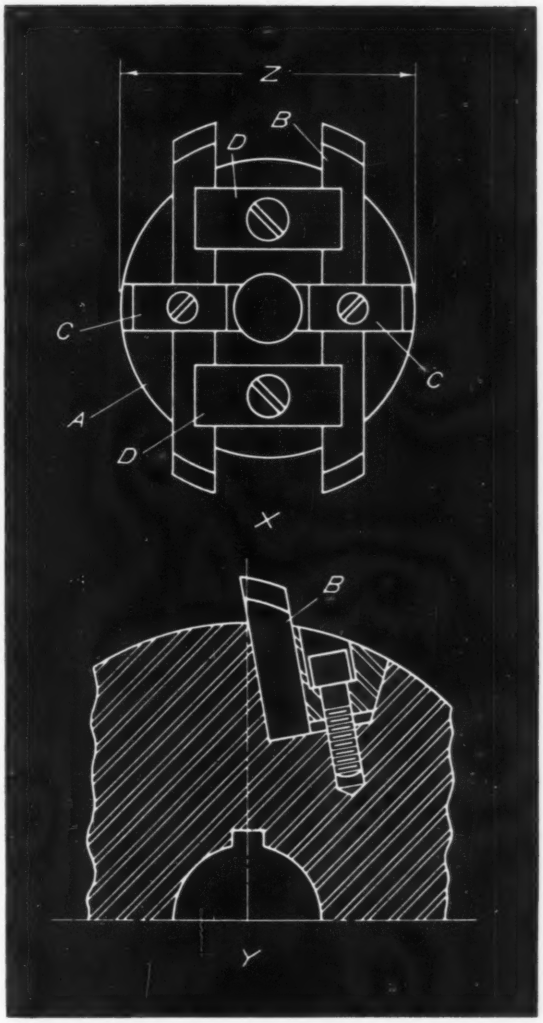
Improvised Method for Grinding Peripheral Clearance on Inserts

By J. Randolph Lucas, Richmond, Va.

Grinding peripheral clearance on inserts for milling cutters can be easily done, even though proper tool-grinding equipment is not immediately accessible. This is possible by using the fixture illustrated at X.

The fixture is designed to accommodate all the inserts from a four-tooth cutter simultaneously. It will not only provide a satisfactory peripheral clearance, but will also keep the length of the cutters equal.

Circular plate *A*, which serves as the fixture body, has a diameter Z that is approximately one-half that of the milling cutter shown at Y. The plate is bored to receive a tapered arbor of suitable size. Inserts *B* are placed in two parallel slots, machined in the face of plate A. Another



Fixture permits grinding of peripheral clearance on milling-cutter inserts (B). All inserts will have the same length after grinding.

slot, which passes across the center of the plate at right angles to the cutter slots, accommodates two stops *C*, against which the square ends of the cutter inserts are placed. Straps *D* are used to clamp the cutters in place. Because of the smaller diameter of the fixture, the inserts have sufficient peripheral clearance when assembled in the larger cutter body.

° ° °

"Torture Chamber" Tests Aircraft

To meet rigid requirements, new military aircraft are tested in a huge "refrigerator-oven" hangar. In this hangar, the airplanes are subjected to temperatures ranging from —65 degrees to 165 degrees F.

Improvements in Hydraulics Discussed at Fabricating Machinery Conference

IMPROVEMENT in hydraulic products, system designs, and maintenance methods was the objective of the recently held Second Fabricating Machinery Hydraulic Conference. Sponsored by Vickers Incorporated, Detroit, Mich., the conference consisted of audience participation in discussions and free exchange of ideas and experiences among about 140 men. Representatives of manufacturers and users of hydraulic presses, and welding, die-casting, and plastic-molding machinery; hydraulic accessory producers; fluid suppliers; and Vickers engineering and service personnel were in attendance.

Co-moderators for the conference were J. R. Hemeon, hydraulic equipment engineer at the Ternstedt Division of General Motors Corporation, Trenton, N. J.; and O. J. Maha, vice-president, Hannifin Corporation, Des Plaines, Ill. After a welcoming address by M. Hayden, general manager, Machinery Hydraulics Division of Vickers, a film entitled "Vickers Hydraulics, a Universal Tool" was shown. This color-sound film illustrates hydraulic applications in machine tools, fabricating machinery, automobiles, aircraft, and materials-handling units.

"Machinery Development, Pacemaker of Plastics Progress" was the title of the keynote address delivered by R. T. Cruse, executive vice-president, the Society of the Plastics Industry, Inc. Mr. Cruse emphasized the importance of hydraulics in the plastic industry and cited the increasing use of plastics for tools, dies, fixtures, piping, packaging, radios, telephones, and housing.

A technical paper entitled "Hydraulic Controls for Flash Welders" was presented by H. Hansen, chief mechanical engineer of the Taylor-Winfield Corporation, Warren, Ohio. Mr. Hansen explained why hydraulic controls were used on his company's machines and elucidated the principles of operation. Essentially, the control of the moving platen during the flashing cycle depends on the use of a spool type follow valve. This servo valve meters hydraulic fluid to the cylinder which actuates the platen.

In that portion of the conference agenda devoted to hydraulic circuit and system problems, it was pointed out that pump cavitation may be caused by too low a pressure, the fluid used, or a restricted inlet. Pressure can be increased by using an overhead reservoir or supercharging. In discussing methods for accurately dividing the flow of hydraulic fluid in the 25- to 75-gallon-per-minute range, the coupling of the drive-shafts of two hydraulic motors together was recommended as more efficient than valving with venturis. For three or more cylinders, gear-motor type flow dividers are available. Also, multiple pumps driven from a single electric motor can be used—

Co-moderators at the Vickers-sponsored Second Fabricating Machinery Hydraulic Conference. O. J. Maha (left) vice-president of the Hannifin Corporation, Des Plaines, Ill., and J. R. Hemeon (right) hydraulic equipment engineer at the Ternstedt Division of General Motors Corporation, Trenton, New Jersey.

selecting as many pumps as may be required.

A question about the use of working pressures beyond 3000 psi stimulated comments from several participants. One company is using 4500 psi at 100 gallons per minute for forging and piercing. Another firm is using 5000 psi at 65 gallons per minute, and 10,000 psi at 5 gallons per minute. Vickers personnel added that they propose to offer equipment for 5000 psi at 100 gallons per minute. In reply to criticism about the slower speed of hydraulic presses, one press manufacturer stated that his company produces a 300-ton, double-action, hydraulic press operating at twenty-two strokes per minute for a draw of 2 to 3 inches. Another company builds 800- to 1200-ton, single- and double-action, hydraulic presses operating at eighteen to twenty strokes per minute for a 13-inch draw. One user commented that his company had a 4-ton, hydraulic press operating at 800 strokes per minute through a 3/8-inch stroke.

In another technical paper presented at the conference, John Lasater, plant engineer at the Soil Pipe Division of Combustion Engineering, Inc., Chattanooga, Tenn., described the application of hydraulics to a high-production foundry. The elapsed time from molten metal to finished product (cast-iron soil pipe and fittings), painted and ready for shipping, is only about thirty-five minutes in this automatic foundry. Pipes are cast two at a time in sand-lined molds with centrifugal machines.

Carl Blanchard, chief engineer of Sheridan-Gray, Inc., Torrance, Calif., read a paper entitled "Hydraulics in World's Largest Stretch-Forming Machine." He described a machine for producing airfoil contours at the dihedral point in aluminum wing panels 50 feet long, 1/4 inch thick, and approximately 10 feet wide at the wing root. The edges of the sheet are gripped and pulled while a die is forced into the sheet to cause the material to yield and take on the desired contour. Four tension cylinders, each capable of exerting a 150-ton pull, are provided on both sides of the sheet. A single, 456-ton cylinder is mounted vertically in the center of the machine to raise the die table into the sheet, and four 600-ton cylinders are mounted in a four-post, vertical arrangement to attach the clamping head to the die table.

In that portion of the conference devoted to pump and valve design, the advantages and disadvantages of central hydraulic systems were examined. Such systems are common in the molding press field, and interest is being revived in their use for die-casting machines, transfer lines, and welding units. One company representative stated they are using three 150-hp, motor-driven pumps for a central system having a capacity of 1200 gallons per minute to operate fourteen die-casting machines. Central systems offer considerable savings for certain applications, but they do not lend themselves readily to changes in plant layout.

Proper cleaning of the hydraulic system, the use of premium oils, adherence to JIC standards, and good maintenance methods were recommended to improve oil life. Also, operation at lower temperatures and the elimination of contamination will reduce the oxidation of hydraulic oils. In the discussion on fire-resistant fluids, it was stated that there are several satisfactory paints available for coating tanks to be used with such fluids. However, one company recommended using unpainted stainless-steel tanks.

In analyzing seals and packings, it was brought out that butyl rubber packings are generally satisfactory for use with most synthetic fluids. Also, some elastometers, as well as polysulphide impregnated leather, show promise for seals and packings compatible with common fluids.

2,000,000-Volt X-Ray Machine to Test Advanced Weapons

The quality of guided missiles, atomic-powered naval ships, and submarines will be closely checked by a new 2,000,000-volt X-ray installation at the U. S. Naval Magazine, Port Chicago, Concord, Calif. The installation will make possible non-destructive testing of vital defense materials and structures.

Castings will be evaluated with the 2,000,000-volt unit before being sent to shipyards that build missiles or nuclear-powered vessels. Services of the X-ray plant will be extended to commercial firms holding government contracts, as well as to other agencies of the Department of Defense.

The unit, built by General Electric's X-Ray Department in Milwaukee, is housed in a newly erected concrete building that is large enough to permit entry of an entire railroad car or large truck. The machine packs enough power to radiograph a complete diesel locomotive. Closed-circuit television facilities will permit remote observation of internal moving parts so that large, complex operating components can be examined without resorting to costly or destructive disassembly.

59 Engineering Students Win Machine Design Awards

The following 1957 graduates have been named by their respective engineering colleges as the recipients of MACHINERY's Achievement Award for outstanding excellence in machine design. In two instances awards were given to the two leading machine design students in their respective graduating classes because of the closeness of their standing.

This is the second year that MACHINERY has presented these achievement awards. Fifty-seven engineering colleges participated as against forty-two in 1956.

Carnegie Institute of Technology	William J. O'Donnell	Pittsburgh, Pa.
Case Institute	Ross A. Hackel	North Olmsted, Ohio
City College	Richard A. Van Valkenburgh	New York City
Colorado School of Mines	Arthur R. Briggs	Golden, Colo.
Colorado State University	Robert C. Lehman	Fort Collins, Colo.
Columbia University	David J. Bennett	Rochester, N. Y.
Cooper Union	Fred Berg	New York City
	Walter Skrabal	New York City
Cornell University	Donald D. Malcolm	Pittsburgh, Pa.
Dartmouth College	Lawrence Furrer	Chatham, N. J.
Drexel Institute	Oscar A. Buchmann	Philadelphia, Pa.
Georgia Institute of Technology	Clinton M. Hunter, Jr.	Greenville, S. C.
Illinois Institute of Technology	Allie M. Baker	Chicago, Ill.
Kansas State University	Donald D. Knudsen	Manhattan, Kan.
Lehigh University	Elden Kunkle	Hellertown, Pa.
Manhattan College	John Walker	New York City
Massachusetts Institute of Technology	George H. Tichenor	Sterling, Kan.
Newark College	Orin A. Sharp, Jr.	Cranford, N. J.
New York University	J. Ernest Wilkins, Jr.	White Plains, N. Y.
Northeastern University	Richard A. Koffinke	Islington, Mass.
Northwestern University	Richard A. Gaggioli	Highwood, Ill.
Ohio State University	Eugene Li Chun Yang	Columbus, Ohio
Pennsylvania State University	Ronald K. Eisenhart	Topton, Pa.
Polytechnic Institute of Brooklyn	Jerome Ostroff	New York City
Pratt Institute	Richard A. Tanzilli	New York City
Princeton University	W. Denny Freeston, Jr.	Bernardsville, N. J.
Purdue University	Howard E. Tatman	New Haven, Ind.
Rensselaer Polytechnic Institute	James B. Roberts	Troy, N. Y.
Rose Polytechnic Institute	Richard E. Hirst	Riverside, Ill.
Stanford University	Kenneth H. Ebersten	Jersey City, N. J.
Stevens Institute of Technology	Edward J. Szczech	Hawthorne, N. J.
Swarthmore College	Robert W. Ellis	Highland Park, N. J.
Syracuse University	Emery P. Gasparek	Endicott, N. Y.
Tufts University	William Warren	Acton, Mass.
Union College	A. H. Williamson, Jr.	Delmar, N. Y.
University of Alabama	J. J. Hicks	Tuscaloosa, Ala.
University of Arizona	Robert W. Bushroe	Tucson, Ariz.
University of California	Norman D. Morgan	Berkeley, Calif.
University of Connecticut	Ronald G. Schlegel	Shelton, Conn.
University of Idaho	Jasper Ross Avery	Orofino, Idaho
University of Illinois	Duane Tonelli	Champaign, Ill.
University of Kansas	Donald K. Hagar	Lawrence, Kan.
University of Maine	William T. Hutchins	Painted Post, N. Y.
University of Minnesota	Donald W. Munson	Minneapolis, Minn.
University of Nebraska	Roland G. Struss	Lincoln, Neb.
University of New Hampshire	Conrad R. Turmelle	Somersworth, N. H.
University of Notre Dame	William L. Howard	Alton, Ill.
University of Pittsburgh	Edward J. McGowen	Pittsburgh, Pa.
University of Southern California	Myron Weiner	Los Angeles, Calif.
University of Texas	Carey E. Murphey	Tyler, Tex.
University of Washington	Duane Roodzant	Oak Harbor, Wash.
University of Wisconsin	Jerome O. Just	Madison, Wis.
Villanova University	Frederic A. Costello	Havertown, Pa.
Virginia Polytechnic Institute	Jerry A. Wilkerson	Richmond, Va.
Wayne University	Richard A. Schapery	Detroit, Mich.
Wentworth Institute	Robert V. Brophy	North Easton, Mass.
	James R. Stewart	Salem, Mass.
Worcester Polytechnic Institute	Joseph J. Weber	Worcester, Mass.
Yale University	Ronald B. West	New Haven, Conn.

Gear Manufacturers Hold Forty-First Annual Meeting

TWO thousand years of technical progress within one lifetime in our present era, if progress is measured by the standards of any previous generation in history, was the theme developed by J. Lewis Powell of the Department of Defense at the Forty-First Annual Meeting of the American Gear Manufacturers Association. The meeting was held at The Homestead, Hot Springs, Va., June 3 to 5, inclusive.

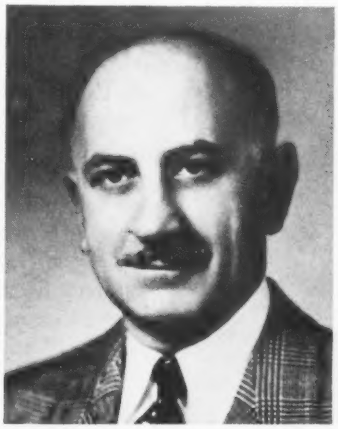
Mr. Powell's talk stressed the "Collapse of Time" as the principal ingredient in man's technological progress. He illustrated this with a graphic blackboard presentation of the Curve of Progress. It showed how in 1830 "Man Broke the Oat Barrier" freeing himself from the limitations of the muscle-power of horses. The curve showed man's continued painstaking progress from 1830 until 1945. Whereas from 1945 until now, progress was by leaps and bounds—an onrushing avalanche. Where it had taken man over a century to go from thirty miles an hour to 470 in 1945, it didn't take ten years to go from 470 to more than 1500 miles per hour.

George H. Acker, recipient of the "Edward P. Connell Award"

Mr. Powell stressed how, in 1945, we revolutionized our thinking. We made "Progress a Product" that could be deliberately achieved by the application of mobilized brainpower. In succession, he contrasted progress in speed, explosives, and the range of missiles against the blackboard graph. In each instance, the graph spectacularly illustrated that the avalanche of technology had created more progress in the last twenty years than in the previous 2000 years.

Mr. Powell pointed out that this avalanche of technological progress had also created an avalanche of obsolescence. He stressed that national security could not rest as firmly as it once did on stockpiled munitions and weapons, since today's electronic wonders would be obsolete tomorrow. Mr. Powell concluded by stating that a well-informed military-industry team is essential to national defense.

Two outstanding technical papers were a feature of the meeting. One of them "Precise Formulas for Over-Pin Measurements of Helical Forms" was prepared by Edward C. Varnum, Head of



Newly elected officers of the American Gear Manufacturers Association (from left to right): LeRoy R. Brooks, president; E. F. Borisch, vice-president; and John L. Buehler, treasurer.

Operations Research, and Stuart J. Johnson, chief engineer, Small Tool Division, Barber-Colman Co., Rockford, Ill.

Professor Earle Buckingham, technical director of Gear Systems, Inc., Boston, Mass., and T. W. Kiralla, president of the same concern, presented a comprehensive treatise on the design of gears for extreme conditions of speed, load, minimum weight, high ambient temperatures, reliable operation for a short length of life, and so on.

An address entitled "Management Development" was given by H. M. Hopkins, vice-president, Tool Steel Gear & Pinion Co., Cincinnati, Ohio. An address was also made by the Association's recently appointed legal counsel, George P. Lamb.

The 1957 "Edward P. Connell Award"—given annually to an individual who has made outstanding personal contributions to further the art of gearing—was presented to George H. Acker, president, Cleveland Worm & Gear Co., Cleveland, Ohio. Mr. Acker has spent over thirty years in the design and manufacture of cylindrical worm-gears and reducers.

The following officers were elected for the coming year: President, LeRoy R. Brooks, president, Tool Steel Gear & Pinion Co., Cincinnati, Ohio; Vice-President, E. F. Borisch, executive vice-president, Milwaukee Gear Co., Milwaukee, Wis.; and Treasurer, John L. Buehler, president, Indiana Gear Works, Inc., Indianapolis, Ind. An ex-executive committee of six members was elected.

"Dual Shield" Welding

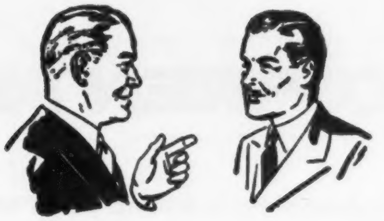
A new shielded-arc welding process permits the operator to see exactly where he is welding. Involved are a flux-core spool electrode and a carbon dioxide atmosphere. Called "Dual Shield," the process has been in the making for over ten years by the National Cylinder Gas Co., Chicago.

"Dual Shield" arc welding, with a flux-core electrode in a carbon dioxide atmosphere

Any type of mild steel can be welded at high rates of metal deposit and travel speed, and with unusually deep penetration. For the first time, it is claimed, the flux is built in the electrode, forming its core. The flux contains an ionizer to stabilize the electric arc; a deoxidizer which permits welding mill-run steel without cleaning it first; and a slag-forming agent. The inexpensive carbon dioxide excludes contaminating air and also introduces a measured portion of oxygen into the weld pool where it combines with additives in the flux to clean the metal.

The result is an arc at least 1000 degrees hotter than the average 9000-degree welding arc. A single pass with a welding gun can weld the full thickness of 1/2-inch steel plate. Welds are stronger because depth of penetration is 40 per cent greater than can be obtained by manual welding with stick electrodes, NCG contends. One shop using the process now allots six minutes to a Dual Shield welding job that formerly took forty-six minutes to perform manually with a stick electrode.

In the training of welders, the process is said to provide savings in time and cost. In a single day, a novice can be taught to do welding of a quality comparable to that of a man who has been instructed for a month in manual welding; in fact, it is possible to do a good semi-automatic welding job after a few minutes of over-the-shoulder observation, a brief explanation, and a few practice passes with the gun.



Talking With Sales Managers

By BERNARD LESTER
Management Consulting Engineer

Uncover the Hidden Cost of Records

ANYONE aware of the upward spiral of sales costs admits that we are in for a season of soul-searching economy. One way to save is to simplify records and paper work after uncovering their hidden costs.

The miraculous equipment for preparing an endless variety of statistical information is certainly fascinating. Thus, many of us become so enchanted with what machines can do to grind out data that we freely accept additional information confident it will be useful. Once automatic office equipment is installed, there is a wave of enthusiasm to employ its various skills.

The cost-tag for producing some metal part that the accountant hands to shop management is readily put to use. But when the accountant passes out commercial statistics data, expense has barely begun. Costs subsequent to preparation remind us of the floating iceberg which is mostly hidden. Here is a spot observation of human behavior which may show how easily we accept statistical data without regard to hidden costs:

> Entering a sales manager's office, a bright accountant was discussing his facilities to furnish records. We overheard him say: "Here are several additional sets of figures we can give you at practically no extra cost. They will round out a really complete statistical picture—a work of art, complete with detail . . ."
>
> "Well, better include them, guess these days you can't have too much information."
>
> When the accountant left, the sales manager exclaimed: "We will have the most complete set of monthly sales records of any manufacturer from Bar Harbor to L.A."
>
> Six months later, the same sales manager was bewailing the pressures of paper work and shortage of time. Pointing to a pile on his desk, he complained: "Am way behind . . . have all that to go over." Batches of pink paper (a color assigned to accounting reports) betrayed numerous sales records—works of art—that were also circulated to other officials.

The chief cost of paper work is not in its preparation. The National Records Management Council figures it costs $1.50 to produce just one letter, or $6200 for the contents of a four-drawer file. But the cost of producing a statistical report usually exceeds that of a letter, and the statistical report is a glutton for executives' time and overhead.

The very small, independent local company ordinarily suffers from lack of sales records. The tendency now for the large corporation—especially the manufacturer of engineered products—is to multiply records, retain most of them too long, and fail to appraise hidden costs.

Extensive statistical records not only consume an executive's energy at a growing rate, worse than that, they keep him from concentrating on more important tasks.

These pointers may help:

1. Though stepping up sales volume to increase profits is loaded with drama, don't forget that savings in paper work and records may outweigh the profit possibilities on additional sales.
2. Establish the principle that sales records have no end in themselves. They are only useful if they lead to profit-making sales.
3. Find out what associates high and low actually do with records relating to sales—not what they say they do with them. The two frequently differ.
4. Study how to save by simplifying records in variety, form, and arrangement, instead of allowing them to get more complex and confusing.
5. Arrange sales reports in relation to items of importance. It is not a question of what people fancy, but what is essential for efficient performance and planning.

To reduce cost of producing statistics is gratifying. The increased hidden costs of using these are alarming.

Let's not get caught, like so many fine old ladies, with an attic full of treasures useless to others and costly to cart away. On the other hand, let us not get caught without essential facts, accurate and well arranged, on which to base the conduct of business.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts and

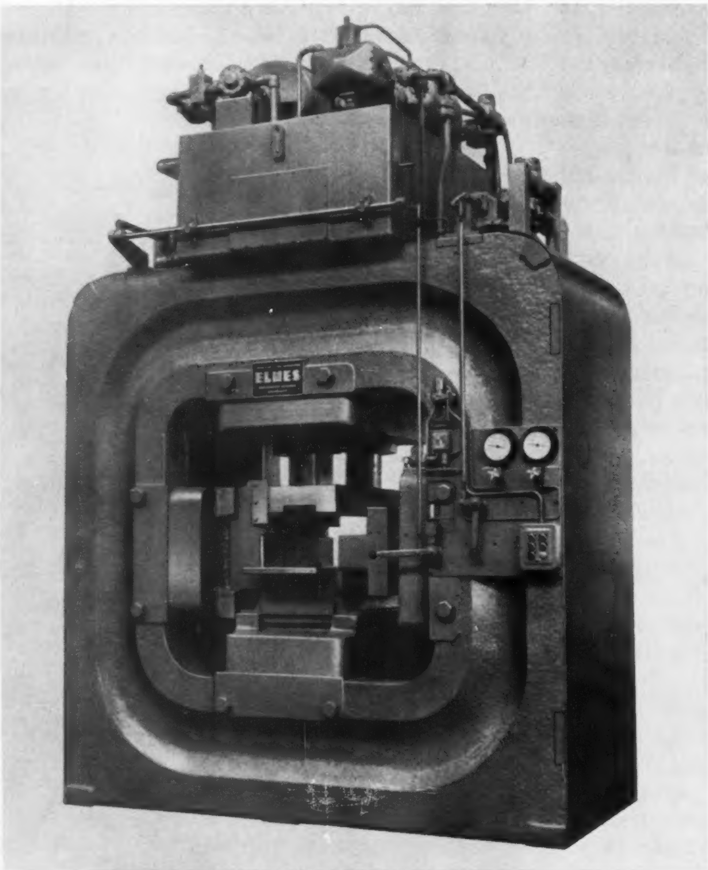
Elmes Hydraulic Press for Powdered Metal Forming

A hydraulic press of improved angle type design for powdered metal forming has been developed recently by the Elmes Engineering Division, American Steel Foundries, Cincinnati, Ohio. The capacity of the main ram of this press is 1000 tons and that of the side ram, 750 tons. Extra-heavy and rigid all-steel box type construction is employed to minimize deflection. Independent hand-lever control is provided for each ram, with a mechanical interlock preventing movement of the main ram until a predetermined tonnage is reached on the side ram.

Manually operated, remote control valves permit variation of the tonnage applied to either ram. The die area is faced with hardened-steel wear plates which are reversible. The working area is readily accessible from either the front or rear of the press. A proportioning type of control on both rams facilitates setting up the dies. The interlocked control is removed during the setting-up operation and is locked in place when the machine is running, to prevent any possible damage to the dies due to malfunctioning. Both main and side rams have rapid approach speeds with slower speeds for pressing and a rapid return speed.

This press is available in a variety of die space and tonnage capacities to meet the user's individual requirements. A third, or bottom, pressing cylinder can be provided as optional equipment.

Circle Item 101 on postcard, page 259



Hydraulic press developed by the Elmes Engineering Division, American Steel Foundries, for powdered metal forming

Kit for Converting Aircomatic Gun for Spot-Welding

Air Reduction Sales Co., a Division of Air Reduction Co., Inc., New York City, has announced availability of an "Aircomatic Spot Kit" that converts standard Model 21 manual Aircomatic gas-shielded metal-arc welding guns for arc spot-welding. The kit consists of an auxiliary control panel, an outer barrel, and a flat nozzle. Spot-welding of lap joints or tack welds in a butt, lap, or fillet joint can be made on mild steels.

Welds are produced by placing the gun against the work and operating the trigger. The heat of the gas-shielded arc between the work and the automatically fed filler wire produces a circular weld. Required amount of filler wire is melted off, being added to the weld for reinforcement. All necessary operations—wire feed, weld time, pre-weld gas purge—are automatically controlled.

Standard Model 21 Aircomatic guns are rated at 350 amperes continuous duty, direct-current, reverse polarity for regular Aircomatic welding. For Aircomatic spot-welding only, the gun can be used at up to 500 amperes direct-current, reverse polarity.

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IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

Multiple-Spindle Drilling and Tapping Machine

The National Automatic Tool Co., Inc., Richmond, Ind., has announced a new standard arrangement of its H-6 multiple-spindle drilling and tapping machine. This machine is now available with pre-set selective cycle control and a straight-line indexing slide. Thus equipped, it makes automated drilling and tapping practical—even for small-lot production of parts usually handled by gang drills.

The operator simply unloads the finished part, loads a new one, and depresses the starting switch. The machine then goes through all operations and returns to the loading position. Over 100 combinations of operations—including drilling, tapping, step-drilling, chamfering, countersinking, counterboring, and spot-facing—are possible by merely setting selector dials.

Table movement in the drilling cycle consists of rapid traverse up, feed up, and rapid traverse down; tapping cycle—rapid traverse up, feed up, feed down, and rapid traverse down; chamfer cycle (including countersinking, spot-facing, etc.)—rapid traverse up, feed up, dwell and rapid traverse down. The table can also be arranged to travel a further distance for drilling than is required for performing the chamfering operations.

Table feeds are controlled by two dials, one for drilling and the other for tapping. Taps of different leads can be used by the vertical float arrangement built into the spindles. The hydraulically actuated indexing slide is electrically controlled by selector switches and is available with two, three, four, or five positions. Various types of work-holding fixtures can also be mounted on the machine slide.

The basic machine consists of a multiple-spindle geared head and a hydraulic feed table. Spindles are driven through universal joints. They can be arranged with adjustable arms for positioning or can be fixed in the required layout by a slip spindle plate, fastened to the head of the machine. Up to twenty-four spindles can be used, depending primarily upon horsepower consumed. A 3-hp motor is standard for the drive on the regular H-6 machine; and a 5-hp motor is specified as standard on the heavy-duty machine.

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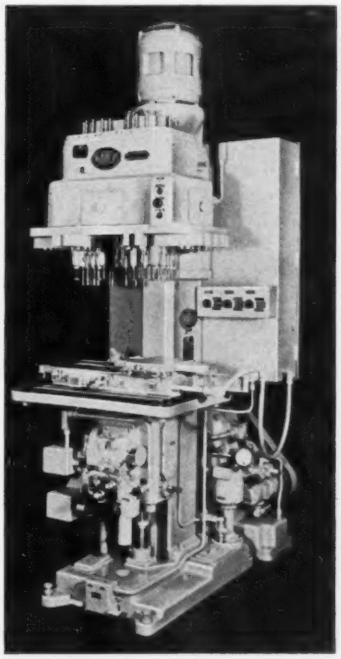


Fig. 1. Natco H-6 multi-spindle drilling and tapping machine available with selective cycle control

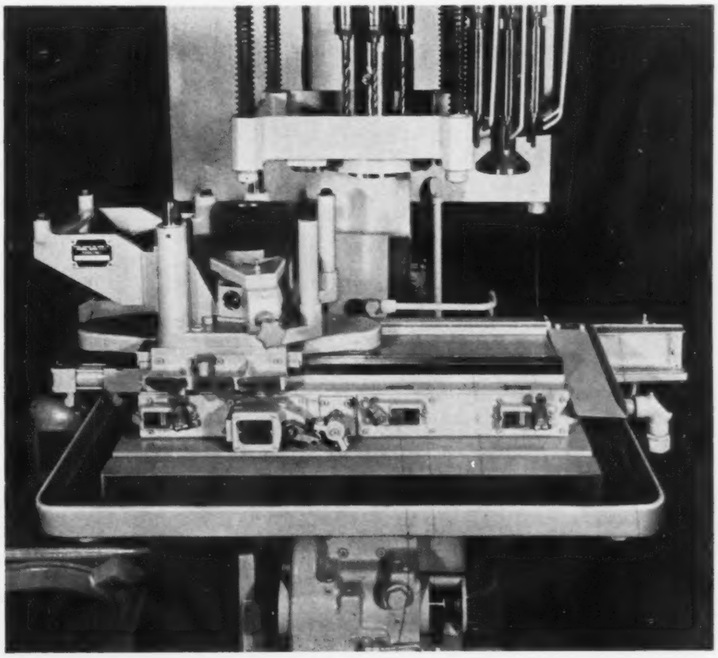
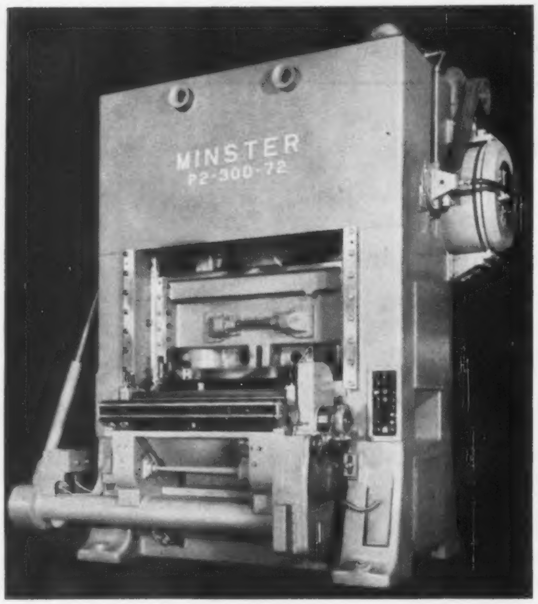


Fig. 2. Typical application of machine shown in Fig. 1 with first position used for unloading and loading. Part is drilled in second position and tapped in the third position.



Center drive automatic production lathe built by Minster Machine Co.

Small-size turret lathe distributed nationally by Cem-Way Sales Co.

Minster Center Drive Automatic Production Press

A 300-ton Piece-Maker P2-300 two-point, straight-side press for automatic progressive production is announced by the Minster Machine Co., Minster, Ohio. This is a single-geared center drive type press, capable of operating in the speed range of 75 to 150 strokes per minute with a standard 3-inch stroke. It is available in bed widths of 66, 72, or 84 inches right to left and 48 inches front to back. The slide measures 34 inches front to back.

The steel herringbone main drive gear is mounted in the center of the two-point, full eccentric crankshaft and is counterbalanced to equalize the weight of the crank eccentrics. This center drive construction reduces torsion, equalizes power transmitted to the slide connections, and makes the use of higher speeds practical.

Standard single- or double-roll feeds are available for feeding from either direction or front to back. The press shown has a single-roll front-to-back feed driven from the crankshaft through spiral miter gears. It is designed to provide maximum stability for continuous heavy blanking operations on materials such as high-carbon steel. Precise slide to bed parallelism even under off-center loading is maintained by the eight extra-long bronze-lined ways, cast gibs, and rigid box type slide construction..

The P2-300 press has a Minster patented combination air-friction clutch and brake unit outboard-mounted on the drive shaft within the press flywheel. A recirculating oil lubrication system provides a continuous oil film to all bearing surfaces. The operator's station, drive, and clutch controls are safely and conveniently located on the press upright. The centralized press control cabinet is mounted off the press.

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Cem-Way Turret Lathe

A No. 00 turret lathe which relieves larger equipment, eliminates re-setup time, and allows final operations to be performed by unskilled personnel, is being distributed by the Cem-Way Sales Co., Bristol, Wis. This lathe —primarily intended for secondary operations—has a single synchronized, cam-actuating lever which locks the work in position ready for centering, cutting-off, spot-facing, drilling, threading, turning, forming, chamfering, and pin-pointing round parts up to 5/8 inch in diameter. It will hold concentricity within limits of 0.0003 inch.

This lathe is small enough to facilitate its use as a portable machine and is designed especially for continuous production of small parts. Having greater sensitivity and faster speeds than larger machines, it will save time and effort on work within its capacity. It can be equipped with a one- or two-speed motor to provide three or six spindle speeds. The control switch is always within easy reach, permitting instant starting, stopping, or reversing of the spindle. The lathe is constructed for Cem-Way Sales by the Clark Engineering & Mfg. Co., Racine, Wis.

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"Skew Loader" Developed for Automated Heat-Treating Line

A "Skew Loader" that enables an operator to load 4200 face-oriented gears per hour onto a gear carrier has been developed by the Gear-O-Mation Division, Michigan Tool Co., Detroit, Mich. Although designed expressly for high-volume heat-treating of

gears, the "Skew Loader" is applicable to many other center-bored parts and production methods.

In operation, the gears enter the "Skew Loader" through a gravity expandable track and are stopped by an escapement mechanism. From the escapement, gears are fed one at a time into a V-track and are pushed forward by the plunger of an air cylinder actuated by a proximity switch. The air cylinder, returning to neutral, triggers a limit-switch-controlled solenoid which releases another gear. This action takes place in split seconds—an average skew load of about fourteen gears is readied in less than five seconds.

When a full load is positioned, the operator merely inserts the skew (or rod) through the center-bored holes and lifts the load onto a gear carrier. The operator's action is almost continuous. Larger or smaller gears can be handled simply by changing the retaining fixtures. The unit is push-button-controlled and can be run manually as well as automatically. The loader requires a floor space only 36 by 36 inches.

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South Bend Vertical-Spindle Precision Milling Machine

A vertical-spindle precision milling machine with improved design features is being built by South Bend Lathe Works, South Bend, Ind. The head of this machine swivels a full 360 degrees on the flanged end of the over-arm for milling, drilling, or boring at any angle. A key with tapered gib prevents the over-arm from turning in the column bearing and permits moving the head transversely without affecting its angular setting. Vernier graduations reading in minutes and worm-gear adjustment facilitate setting of head angle with extreme precision. The over-arm is 4 1/2 inches in diameter, has rack-and-pinion cross movement of 15 inches, and can be locked rigidly at any point.

The milling machine base has been enlarged and strengthened. Table feed-screws are equipped with large handwheels. Dual controls permit operating table from either end. The micrometer collars on the feed-screws have a frosted finish with black graduations which serve to eliminate eyestrain.

The table is 9 inches wide and is available in 32- and 42-inch lengths, providing 20- or 30-inch longitudinal travel respectively. Vertical adjustment of table is 18 inches. Maximum distance from table to spindle is 20 inches and from spindle to column, 20 inches. Adjustable stops regulate the length of table feed. Measuring trays with dial indicators are available for precision positioning of the table with both the cross-feed and longitudinal feed-screws.

The spindle has a No. 30 milling machine taper with 3/4-inch collet capacity. It has a 4-inch vertical travel with lever for rapid movement and handwheel for slow feed.

A precision micrometer depth stop and positive quill lock are provided. Compound V-belt and timing belt drive transmits power to the spindle. This machine is provided with eight spindle speeds that range from 90 to 2500 rpm with a 3/4-hp motor having a speed of 1200 rpm, or 135 to 3750 rpm with 1-hp motor operating at a speed of 1800 rpm.

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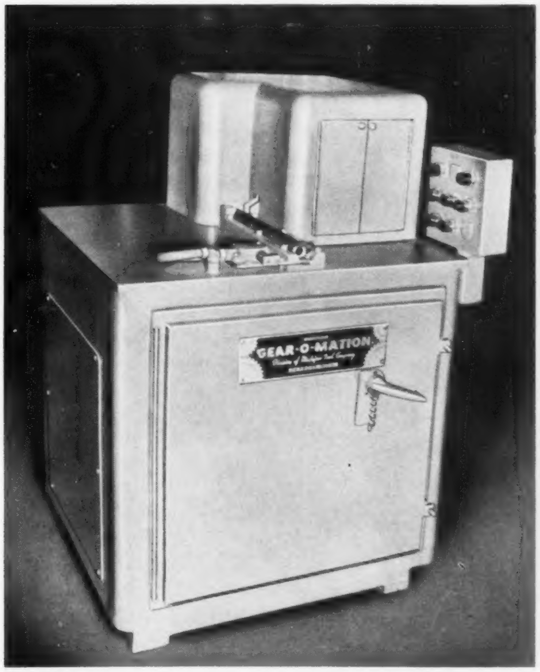
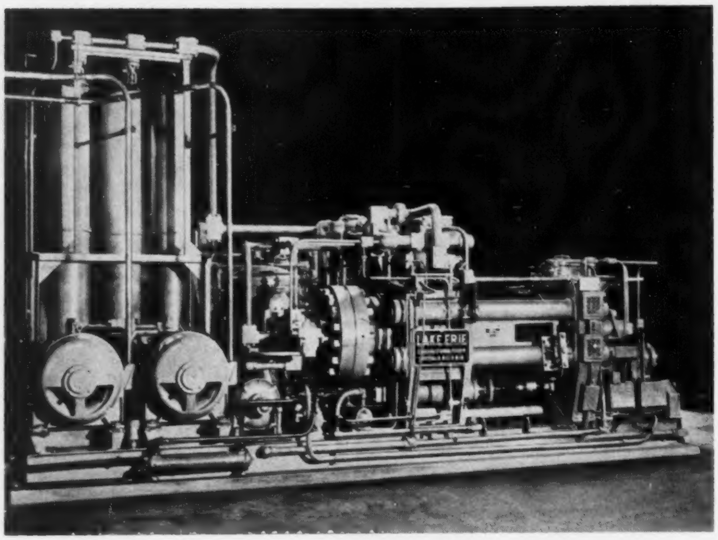


Gear-O-Mation "Skew Loader" for automated production line developed by Michigan Tool Co.

Vertical-spindle precision milling machine built by South Bend Lathe Works

Cold-Extrusion Press



Lake Erie cold-extrusion press

Several cold-extrusion presses developed and built by the Lake Erie Machinery Corporation, Buffalo, N. Y., have extruded automobile torsion bar anchor housings from 1035 steel at a rate of 525 per hour, holding concentricity to 0.010-inch total indicator reading.

The presses are rated at 440-tons extrusion and 44-tons ejection pressures. The high production rate is obtained by automatic cycling in conjunction with a special five-station patented dial feed: the dial has two movements—axial and rotary. A hydraulic cylinder moves the dial axially to clear the fixed tools during indexing. Each time a billet is extruded, a new one is fed into a dial station and an extruded billet is stripped from the die. The versatility of the press is such that production possibilities are limited only by the die-holder size, configuration of the part, and tonnage capacity of the press.

Approximately 24 feet long, the press has a 51-inch daylight capacity and an 18-inch main ram stroke. Approach speed is 1200 inches per minute, and extrusion speed, 500 inches per minute at 2550 psi.

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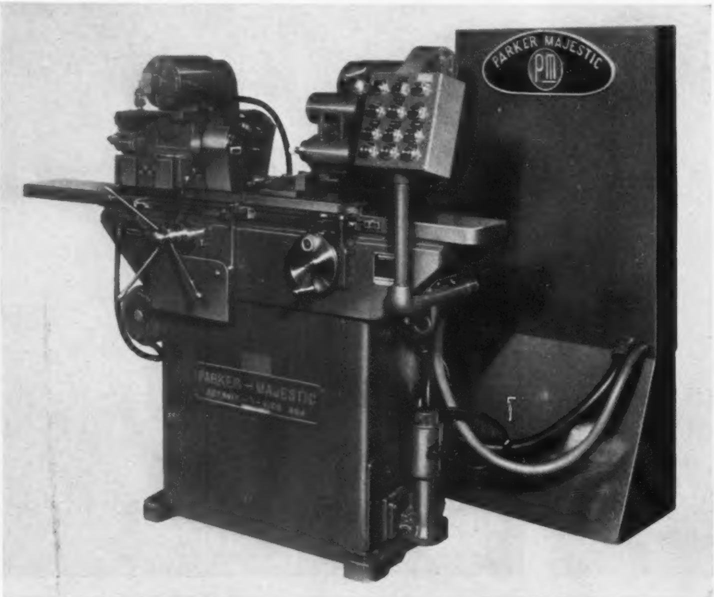
Semi-Automatic Internal Contour Grinder

The Parker-Majestic, Inc., Detroit, Mich., has announced a semi-automatic internal contour grinder which has a cam and cam follower installed at each end of the work-head. This arrangement prevents any possible twisting or binding and insures a smooth follower action. The infeed of the grinding wheel is controlled by a cam. When this cam is rotated by means of a ratchet mechanism through 360 degrees, it completes a cycle consisting of rapid infeed for roughing, dwell for wheel dressing, and finally a slow infeed for finishing.



Parker-Majestic semi-automatic internal contour grinder

Sizing is accomplished through the use of a micrometer type wheel dresser which, when positioned, insures a high degree of accuracy in the production of duplicate parts. Table movement is energized by any one of three built-in methods: hand feed using the capstan type handwheel; power feed through a gear-driven mechanism electromechanically controlled for the full table travel of 12 inches; and the use of a reciprocator mechanism in which the stroke is adjustable from 0 to 3 inches.

It is a simple matter to change work-head cams to permit grinding many different internal forms. This feature is particularly desirable when relatively short-run production on several parts is demanded. The swing over the table is 10 inches, and the maximum table travel is nominally 12 inches. The machine shown in the illustration weighs approximately 2500 pounds.

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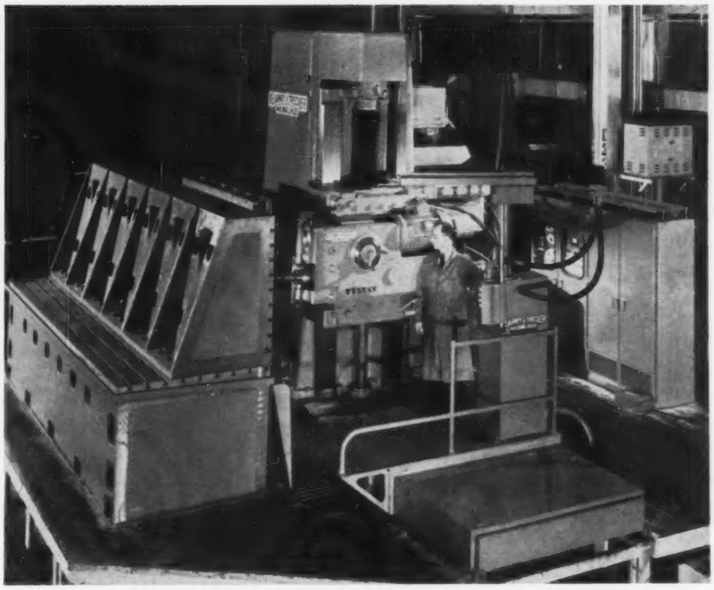
Profile-Milling Machine with Numerical Control

A numerically controlled profile-milling machine built by the Kearney & Trecker Corporation, Milwaukee, Wis., has recently been tested by the Air Materiel Command at the Wright-Patterson Air Force Base in Ohio. This is the first of twenty-two machines of this type to be produced by Kearney & Trecker under the Air Force machine tool modernization program.

The new profile machine shown can be used for milling high-tensile steel as well as aluminum and exceeds the National Aircraft Standards' production requirements in both feed rate and revolution per minute ranges. The feed rates are from 1/50 inch to 100 inches per minute. The spindle is powered by a 20-hp motor and operates within a speed range of 36 to 1800 rpm.

The machine operates from digital information punched on a plastic tape and translated into code by an interpolator. Movements in three directions are obtained by signals generated from the coded information that defines the desired shape of the finished work-piece. High-speed digital computers are used to process the data required by the new method of motion control, which was developed and built by the Bendix Aviation Corporation.



Kearney & Trecker profile-milling machine controlled by punched tape

The work of these profile millers is not confined to the aircraft industry but can be applied to all metalworking industries including those using high-tensile steels as components.

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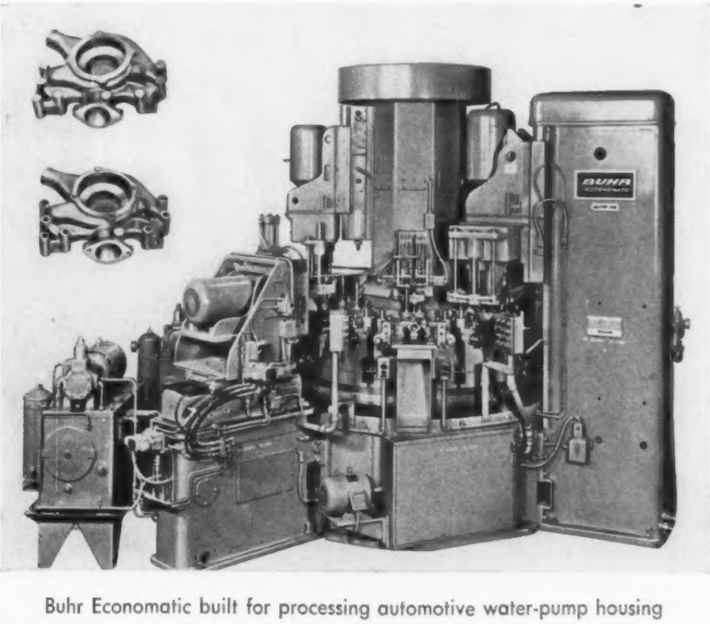
Economatic Built to Process Water-Pump Housing

The Buhr Machine Tool Co., Ann Arbor, Mich., recently built an Economatic for high-speed processing of an automotive part. Two noteworthy features of this machine are: ease of conversion for machining other parts; and provision for removing the automatic index unit which actuates the table without disturbing any other part of the machine. Other features include: automatic clamping of parts, automatic lubrication of fixtures and all moving parts, steel hardened-and-ground detachable ways, complete interchangeability of standard and special parts, automatic chip removal, and construction to JIC standards.

This machine was built specifically to perform fifty-five operations on an automotive water-pump housing after the mounting pads have been ground. Processing the pump housing on the Economatic, equipped as shown in the illustration, consists of performing one milling, eighteen drilling, ten reaming, seven chamfering, ten tapping, seven spot-facing and two boring operations.



Buhr Economatic built for processing automotive water-pump housing

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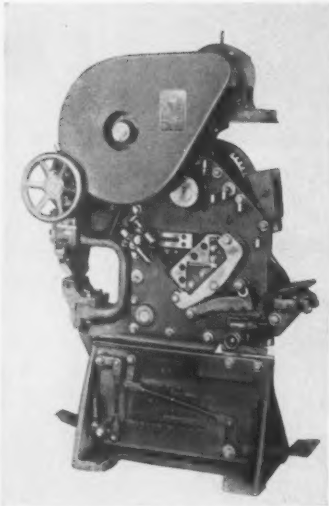

Combination shearing, punching, and coping machine marketed by Joseph T. Ryerson & Son, Inc.

Shearing, Punching, and Coping Machine

Joseph T. Ryerson & Son, Inc., Chicago, Ill., is marketing a combination machine for manufacturers of heating and ventilating equipment, construction companies, maintenance shops, and metal fabricators that require high-speed punching, shearing, and coping equipment. This machine punches up to and including 13/16-inch diameter holes in 3/8-inch thick steel plate, and up to and including 11/16-inch holes in 1/2-inch plate. It shears up to and including 4- by 4- by 1/4-inch steel angles, 4- by 1/2-inch flat bars, 1 3/8-inch round bars, 1 1/4-inch square bars, and 3/8-inch thick steel plate. It also performs notching and coping operations. Larger-capacity units of this machine are also available.

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Hydraulic Forging Manipulator

A German-built forging manipulator in which all movements are performed hydraulically is being distributed in the United States by the Industrial Equipment Division of the Kurt Orban Co., Inc., Greenwich, Conn. One or two pressure pumps driven by electric motors deliver water to an accumulator at a pressure of 1420 psi for operation of the manipulator. From the accumulator, the pressure water is directed to the control center which, in turn, supplies pressure water as required to the various working cylinders. All functions such as traveling, movement of the gripper, and opening and closing of the jaws are obtained solely by the hydraulic system.

The one or two electric motors required to drive the pumps can be of relatively low power, because the energy for feed power demand is stored and supplied by the hydraulic accumulator. No regulators and clutches are required, and all movements are uniformly variable. An overburdening of the hydraulic system is prevented by a built-in overload protection device. The manipulators are built in standard sizes, ranging from a carrying capacity of 5500 pounds to 220,000 pounds.

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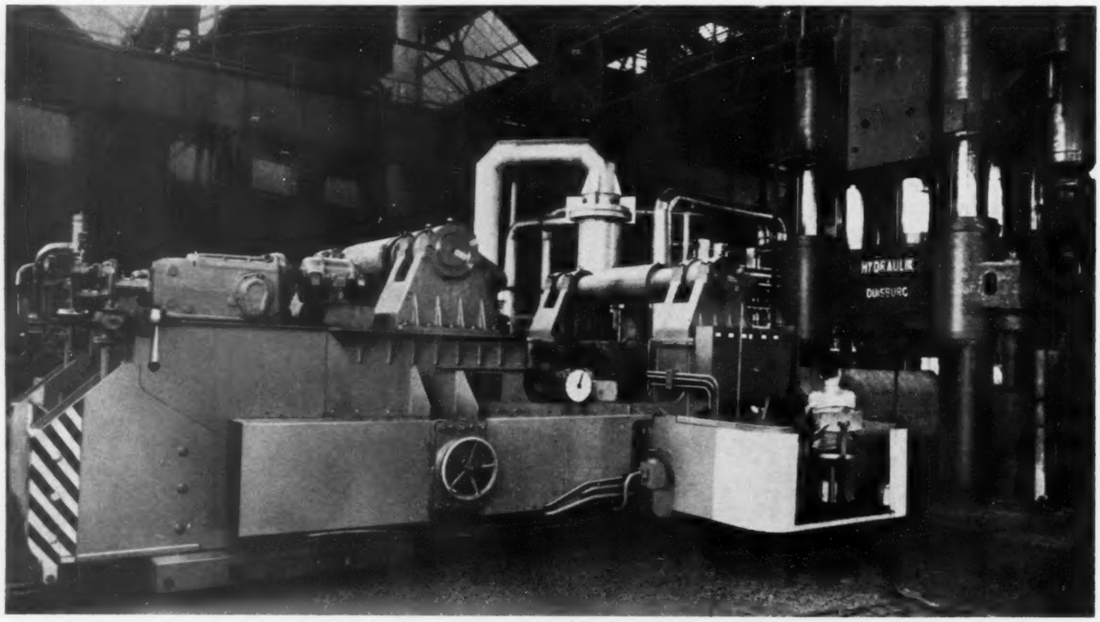
DoALL Low-Powered Saw

The DoALL Co., Des Plaines, Ill., has introduced a Model C-12 power saw for tool and die, maintenance, and similar shops. This saw can be operated by unskilled workers and can be set up quickly and run at high speed. It will handle 12-inch rounds, 12-by-12-inch square stock, and work weighing up to 1500 pounds.

Four speeds are available by means of step pulleys, so that one may be selected to suit the spe-



Hydraulic forging manipulator introduced in this country by the Kurt Orban Co.

Fig. 1. Low-powered saw introduced by the DoALL Co.

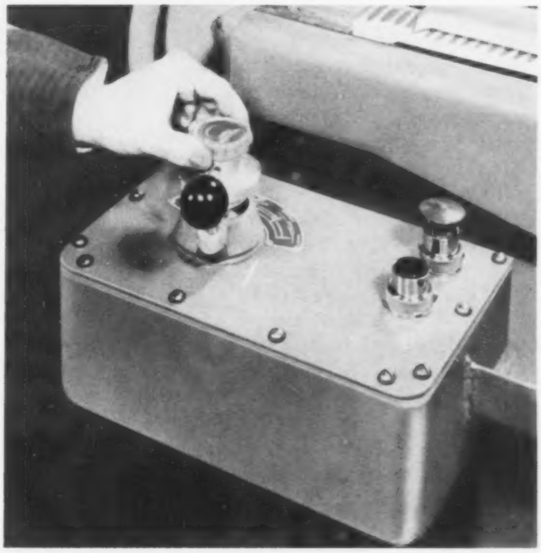


Fig. 2. Valve controls for machine shown in Fig. 1.

cific job. The built-in coolant system and hydraulic band tension control assure long blade life.

The start-stop push-buttons for the electric motor and the control for the hydraulic feed are conveniently grouped together on a panel near the front of the machine, Fig. 2. There is also an automatic hydraulic lock to prevent movement of the cutting head in case the electric power is cut off or in case of power failure. The four-position hydraulic valve, Fig. 2, controls the movement of the sawing head. The valve provides rapid traverse for either up or down direction, stop, and feed. In the feed position, a calibrated control permits an infinitely variable feed rate.

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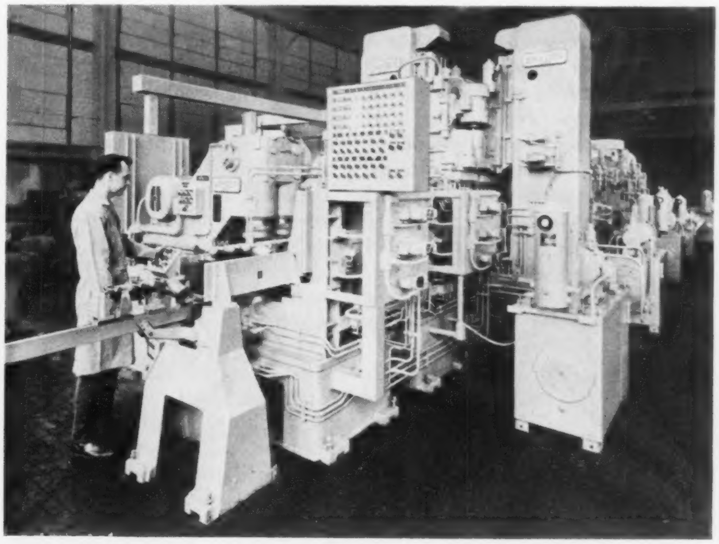
Snyder Transfer Machine for Processing Two Different Parts

A segmented, in-line transfer machine built by the Snyder Tool & Engineering Co., Detroit, Mich., mills, drills, chamfers, and taps two different automotive engine exhaust manifolds at a net production rate of 136 manifolds per hour. Built-in sensing devices in the twenty-eight-station, 63-foot long automated machine make it possible for the two different parts to be processed.



Segmented transfer machine for processing two different parts built by the Snyder Tool & Engineering Co.

The joint faces of the two manifolds are identical and the milling, drilling, and tapping operations are first performed on these areas. Additional clamping support is required for drilling, chamfering, and tapping one of the manifolds. This support is provided at these stations by sensing devices that find the work by detecting a cast surface and causing a hydraulically operated clamp to engage the part.

The next operations on the manifolds are performed after the parts are automatically turned over by a rotating fixture. These subsequent milling, drilling, chamfering, and tapping operations are not common to both parts. Part A is processed through these operations and passes through the balance of the machine with the stations automati-

cally idled by sensing devices that detect one part from another by searching for the cast surface. Part B has idle stations through the first operations and is processed in the last stations on the machine.

Probing stations that check all holes and shut down the machines if any incomplete holes or broken taps are detected are provided in four stations of the machine. The machining units are of the Snyder standard type with hardened and ground ways; seven way type units and eight self-contained units are used. Tapping head spindles have individual lead-screw drives. The machine is hydraulically operated and electrically controlled.

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Microscope for Toolmakers and Machinists

A microscope of improved design for use by machinists and toolmakers in the inspection and measurement of tools, drill jigs, templates, and finished parts has been announced by the Bausch & Lomb Optical Co., Rochester, N. Y. This toolmaker's measuring microscope, is designed to provide the versatility, convenience, sturdiness and accuracy previously available only in higher priced equipment.

Standard magnification is 35X, but different objective and eyepiece combinations may be used to obtain other magnifications.

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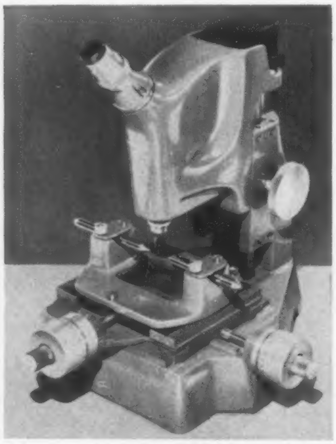
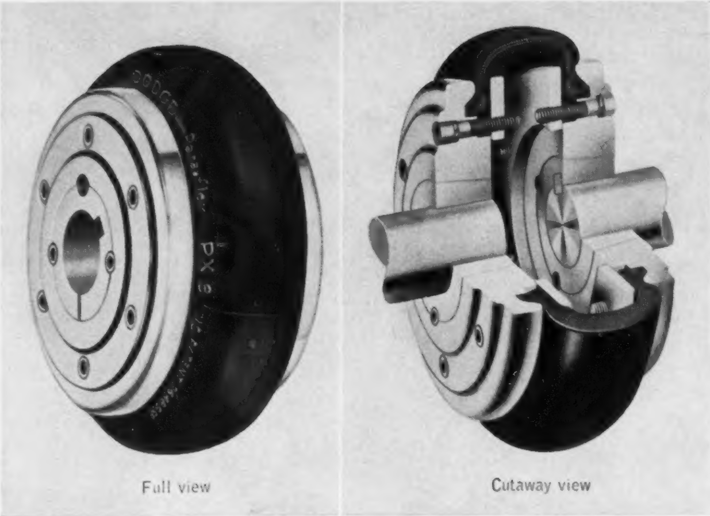


Bausch & Lomb toolmaker's microscope



"Para-flex" flexible coupling introduced by the Dodge Mfg. Corporation

Dodge "Para-flex" Flexible Cushion Coupling

A flexible coupling of entirely new design, called "Para-flex," is announced by the Dodge Mfg. Corporation, Mishawaka, Ind., as the latest addition to its line of power transmission machinery. The ability to handle angular and parallel misalignment, as well as end-float, is only one of many advantages claimed for this coupling. The flexible member also serves to cushion shock loads and diminish torsional vibration.

The heart of the coupling is a tire with synthetic tension members bonded together in rubber. In fact, the new coupling is said to have been made possible by developments in the process of manufacturing automobile and truck tires to carry tremendous loads at high speeds and to withstand terrific shocks. It is claimed that the four-way flexing body of "Para-flex" supersedes the most complex coupling mechanisms, yet it operates with the simplicity and dependability of a modern tire.

In addition to operational advantages, the coupling has features that facilitate installation and maintenance. It is simple and dependable, consisting essentially of the flexible tire clamped between two hubs which are mounted on the shafts to be coupled, as shown in the cut-away view in the illustration. The flexible member is held between the flanges and clamp rings of the hubs. Both hubs of the coupling are machined to take Taper-Lock bushings that give the equivalent of a shrunk-on fit on the shaft and permit quick and easy application to shafts of different diameters.

A transverse split in the tire permits easy installation and, also, makes replacement possible without moving the driving or driven machine by simply loosening the cap-screws.

The "Para-flex" coupling will take angular misalignment up to 4 degrees, parallel misalignment up to 1/8 inch, and end-float up to 5/16 inch—contingent upon the size of the coupling and the duration of the conditions—or it will take all of these simultaneously. Torsional vibration developed by internal combustion engines is absorbed to a great degree.

Because there is no metal-to-metal contact in the "Para-flex" coupling, it requires no lubrication. The coupling, developed in West Germany, has been adapted to the standards of American industry by the Dodge Mfg. Corporation and will be stocked by its distributors in popular transmission sizes. It is available from factory stock in capacities from 4 hp at 1800 rpm up to 600 hp at 900 rpm.

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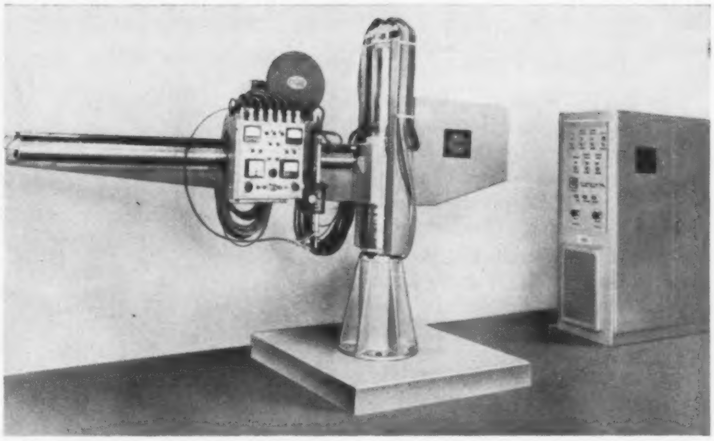
Welding Head Manipulator and Control Console



Welding head manipulator and control console made by Air Reduction Co.

A welding head manipulator and control console for longitudinal and circumferential welding has been brought out by the Machine Welding Department, Air Reduction Sales Co., Division of Air Reduction Co., Inc., New York City. The unit was engineered by Airco's machine welding department to facilitate universal positioning and accurate variable-speed traversing of the welding head. The manipulator is of all-welded construction and is especially designed for precision welding applications on aircraft jet-engine components and similar intricate parts. Both "Heliwelding" (tungsten inert-gas arc welding) and "Aircomatic" (metal inert gas arc welding) automatic heads may be mounted on the manipulator.

The electrical console provides all the necessary controls for complete programming of the welding operation, electronic timers being provided for sequence control. The console includes a welding power source with current slope control, accessories for control of shielding and back-up gases, a self-contained water circulating unit, and other features.

The welding head manipulator and control console can be designed and constructed to suit each production-line application.

Circle Item 118 on postcard, page 259

Van Norman Milling Machines

Three new models have been added to the ram type milling machines manufactured by the Van Norman Machine Co., Springfield, Mass. All three machines—24LA, Fig. 1; 24MA, Fig. 2; and 24MLA, Fig. 3—feature the exclusive Van Norman adjustable cutter-head which permits horizontal, vertical, and angular milling to be readily performed on one machine.

The 24LA and 24MLA machines have nine spindle speeds, ranging from 50 to 1400 rpm; and the 24MA has twelve spindle speeds, ranging from 40 to 1600 rpm. All these machines have a cross travel of 12 inches and a longitudinal travel of 28 inches. The 24MA and 24MLA machines have a vertical travel of 23 inches, while the 24LA has a vertical travel of 20 inches. The table of the 24LA machine is 50 by 10 1/2 inches and that of the 24MA and 24MLA is 50 by 12 inches.

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Chicago-Latrobe Extra Long Drills

Extra long drills of high-speed steel with straight shanks in wire gage sizes No. 52 through No. 1, in fractional sizes from 1/16 through 1/2 inch in diameter, and also with taper shanks in sizes from 1/8 inch through 1 1/2 inches in diameter are available from Chicago-Latrobe, Chicago, Ill. Regular sizes have maximum length of 18 inches.

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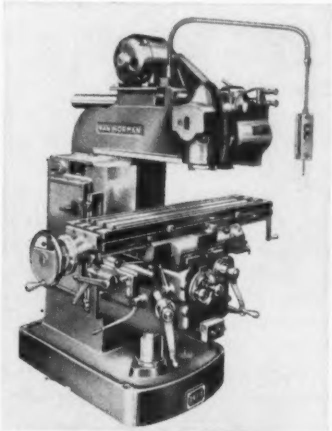

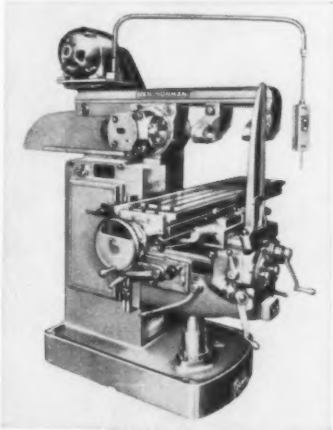

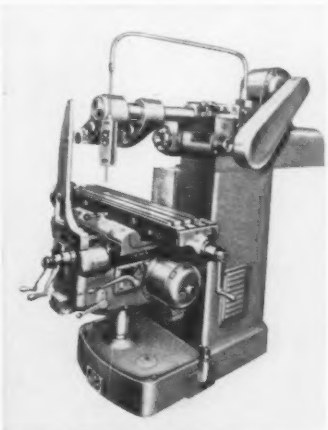

Three milling machines—designated 24LA, 24MA, and 24MLA—made by the Van Norman Machine Co.

Bliss High-Speed Forging Press

The E. W. Bliss Co., Canton, Ohio, has recently redesigned its line of high-speed forging presses. Among the new features is a tonnage limiter which prevents accidental overloading of the press by automatically reducing the air pressure on the clutch as the slide approaches the bottom of the stroke and increasing it on the return stroke.

The brake has also been redesigned: a double rather than a single clam shell brake is now used. This has increased the braking area and, along with the application of a larger cylinder, has served to double the braking effect.

Other features include: air counterbalances instead of the previously used "buffers;" air-actuated wedge type die seat, redesigned flywheel brake; and new gear drive for both the limit switch and lubrication pump, replacing the earlier sprocket drive. All of the forging presses of the company's line are now built with a solid frame.

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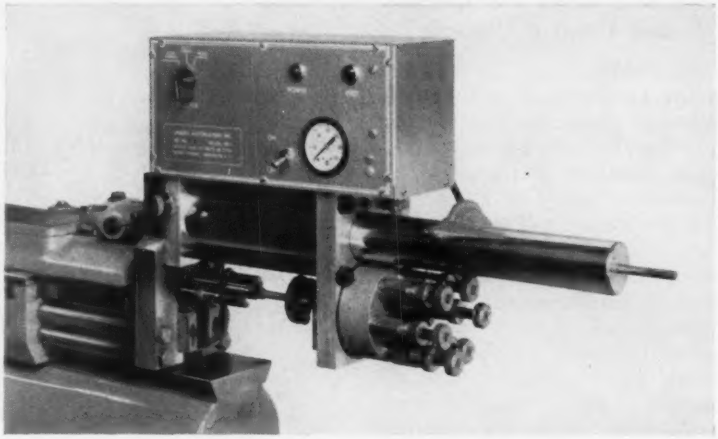


Sandex automatic power feed for turret lathes

Redesigned high-speed forging press announced by E. W. Bliss Co.

Automatic Power Feed for Turret Lathes

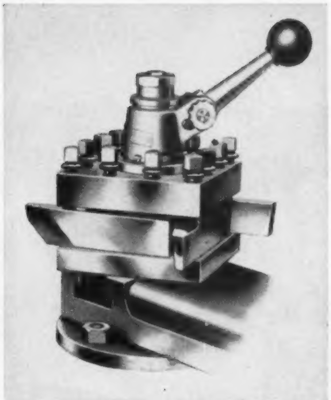
Sandex Automation, Inc., Brooklyn, N. Y., is manufacturing a line of automatic power feeds for machine tools. The Model HR-1 turret lathe installation shown in the illustration features a separate feed for each turret position with infinitely variable feed adjustments. It operates on an air pressure of 50 to 100 psi and incorporates a hydraulic cylinder which gives it an extremely precise feed that is easily varied by simply turning a feed-screw for each position. This unit indexes the turret automatically and provides fast approach and return feeds.

Circle Item 122 on postcard, page 259

McCrosky Turret Toolposts with Clamping Type Handle

A novel clamping type handle is a feature of the turret toolposts recently introduced by the McCrosky Tool Corporation, Meadville, Pa. The clamping handle assures positive locking—even when handling interrupted cuts or the fast feeds and speeds of heavy-duty production lathes. The action of the handle is fast and simple. Raising the handle from an approximately horizontal position to about a 45-degree angle clamps a locking collar tightly around the center column of the turret with a powerful cam action.

The turret is unlocked simply by lowering and pushing the han-



Turret toolpost introduced by the McCrosky Tool Corporation

dle slightly. This permits the turret to be rotated freely to any of twelve indexing positions to bring the required tool for the next operation into the proper cutting position.

Turrets with this clamping type handle are available in three styles and eleven different sizes for mounting in the T-slot of the compound rest or the bolt circle of the main slide.

Circle Item 123 on postcard, page 259

Large-Capacity Metalworking Press

The Federal Press Co., Elkhart, Ind., has added a Model 55, large-capacity press to its line of metalworking machines. This 56-ton unit is designed with over-size dimensions to accommodate larger dies. It will economically handle lamination, die-casting, trimming, and a wide range of similar operations which would otherwise tie up larger and more expensive equipment.

The standard stroke of the new press is 4 inches, but strokes up to 12 inches are available at extra cost. Standard ram area is 11 1/4 by 24 inches, but provision can be made for ram areas up to 11 1/4 by 36 inches.

A normal press shut height of 12 1/4 inches is standard. A shut height of 21 inches is obtained by means of a frame extension. A throat depth of 15 inches is standard, but a depth of 17 inches is also available.

The regular standard opening through the back is 22 inches, but an opening of 26 inches can be furnished. The bolster plate is 36 by 28 inches. This press is built in either the flywheel or geared type, in mechanical or air clutch models.

Circle Item 124 on postcard, page 259

Hydraulic Motor Drive for Mechanical Type Broaching Machine

High-speed vertical and horizontal mechanical type broaching machines produced by the Colonial Broach & Machine Co., Detroit, Mich., are now available with hydraulic motor drive for the main driving gear. The hydraulic unit and motor assemblies are said to be economical in initial and installed cost.

Hydraulic motor operation is immediately available on all Colonial mechanically driven broaching machines up to the 10-ton capacity models. Simplicity and smoothness (even of start-stop operation) are important features of the machines equipped with the hydraulic motor drives which will be marketed under the name "HydroGear."

Circle Item 125 on postcard, page 259

Federal Model 55, large-capacity metalworking press

Colonial hydraulic motor drive for broaching machine

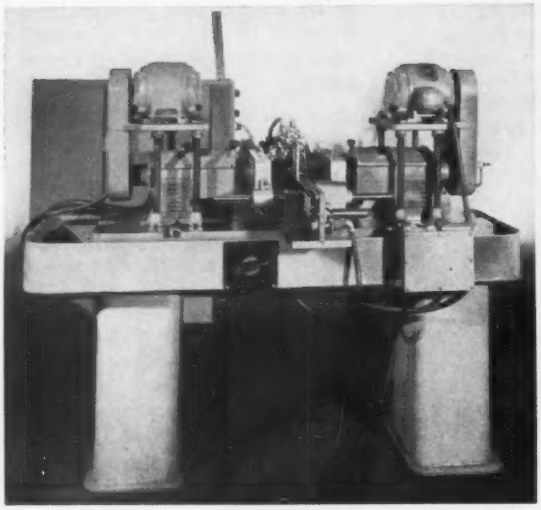


Fig. 1. Special tapping machine built by the Ettco Tool & Machine Co., Inc.

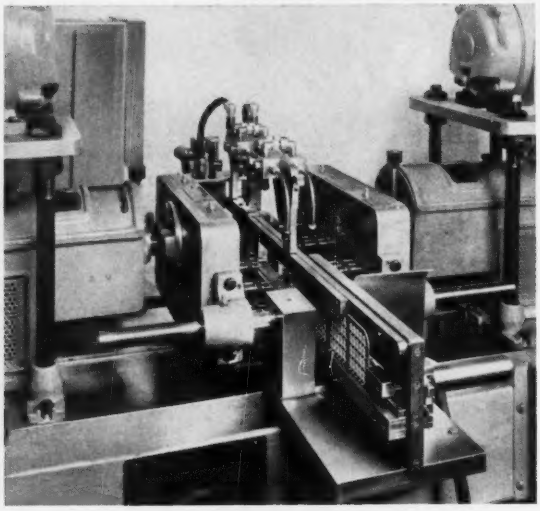


Fig. 2. Close-up of Ettco-Emrick tapping machine shown in Fig. 1

Ettco-Emrick Machine Taps 28,800 Holes per Hour

The Ettco Tool & Machine Co., Inc., Brooklyn, N. Y., has built a special machine for tapping 6-32 holes (7/16 inch between centers) in either of two different types of brass terminal inserts set in phenol fiber—forty holes in one part and twenty in the other—at the production rate of 720 completed parts every hour. Standardized "unit-engineered" Ettco-Emrick components were used in building this special two-way, horizontal, automatic lead-screw tapping machine equipped with vacuum mist lubrication and chip disposal system. With this machine either part can be produced at the required production rate. Operating at 100 per cent efficiency, a part is produced at each stroke of the machine. This is equivalent to a production rate of 28,800 holes per hour.

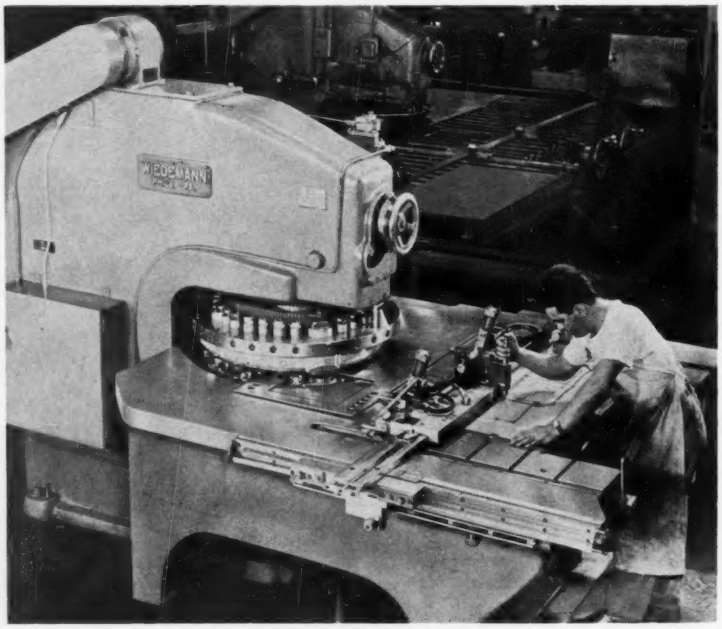
Parts of either type are hand-loaded vertically into a track (see Fig. 2) and pushed forward into the work position by means of a hand-actuated fixture. When the part is in position, two synchronized horizontal A.T.U. No. 3 lead-screw tapping units are actuated. These units, each of which is set up with a twenty-spindle multiple head, also have pickup rods and a safety device to assure error-proof positioning of the parts—a feature that eliminates spoilage and tap breakage.

As each part is progressively fed through the two work-stations, one completely tapped part, free from oil or chips, is automatically ejected into the tote box. Since the parts must be dry, mist-fed lubrication is used.

Circle Item 126 on postcard, page 259

Turret Punch Press with High-Speed Follower Gage

The Wiedemann Machine Co., Philadelphia, Pa., is manufacturing a RA-61 turret punch press designed for economical high-speed piercing of truck parts, heavy electronic chassis, panels, side-plates, and other sheet-metal or plate parts in low to medium production quantities. This 40-ton capacity press, equipped with the



Wiedemann turret punch press

Wiedemann high-speed follower gage (pantograph), eliminates setup and work layout operations. Flat sheet metal or plate up to 33 by 40 inches is pierced in one handling. Work is located to close tolerances and pierced at the rate of thirty or more holes per minute.

The power-operated RA-61 press provides maximum flexibility with respect to the shape and size of punches and dies that can be used. Its rotating turrets house twenty to twenty-eight tools which can be brought into the piercing position in three to five seconds.

Work is secured to the cross-slide of the mechanical follower gage. Therefore, it follows the slide accurately in any direction as the operator moves the control stylus from hole to hole in a color-coded template clamped to the table. When the stylus point enters a small diameter hole in the template, the work is properly positioned, and the press is automatically tripped.

This heavy-duty press, with a throat depth of 33 inches, will punch holes up to 6 inches in diameter in 1/8-inch mild steel or up to 1 1/2 inches in diameter in 3/8 inch mild steel.

Circle Item 127 on postcard, page 259

Single-Geared, Double Crank, Straight-Sided Press

The Cleveland Punch & Shear Works Co., Cleveland, Ohio, has announced a 200-ton single-geared, double crank, straight-sided press. This press is equipped with twin drive and an electrically controlled heavy-duty drum type friction clutch with air brake. The flywheel has an auxiliary air brake to permit quick stopping when the power is suddenly shut off. The press has an 8-inch stroke, 10-inch adjustment of slide, shut height of 30 inches, slide or plunger face 48 by 96 inches, and a bed opening 33 by 81 inches.

Presses in this series are available in capacities of 75, 90, 110, 120, 150, 200, 250, and 350 tons. They can be modified in respect to die space, stroke, adjustment, bed area, etc., thus offering an almost unlimited number of combinations. The variety of sizes and capacities in which the presses are available provides for the handling of material of any thickness from light sheet metal to heavy steel plate. The presses are built in single-geared, double-geared and flywheel types, and can be used for such operations as punching, forming, stamping, bending, cutting, and light embossing—usually of large or irregular shapes. The twin drive is used exclusively on the larger presses and where work is heavy.

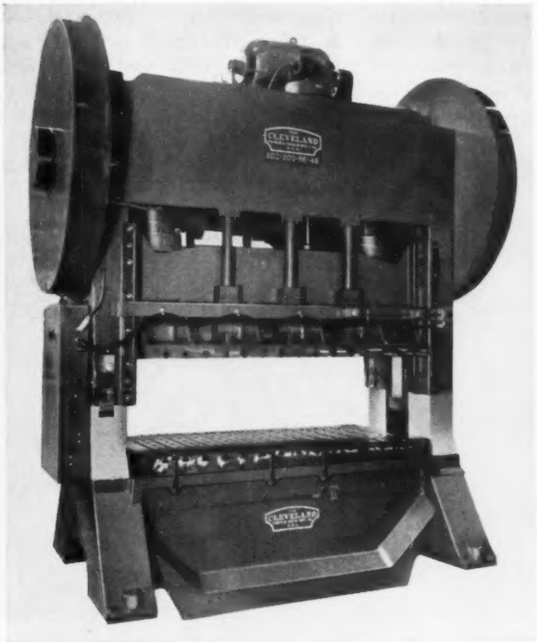
Circle Item 128 on postcard, page 259

Escapement Type Universal Spring Coilers

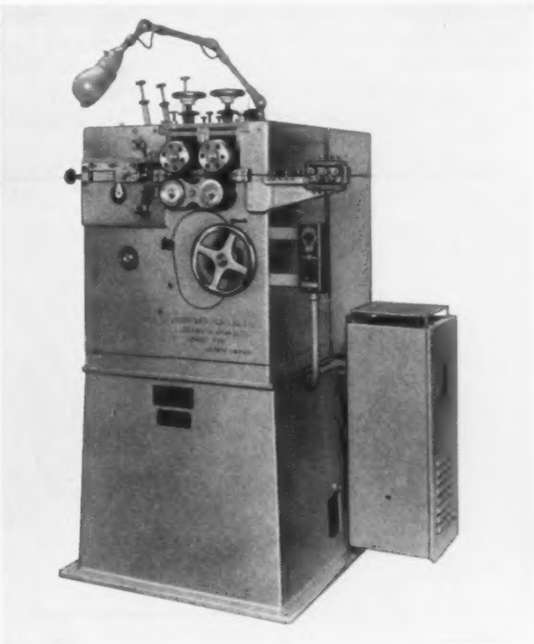
Universal spring-coiling machines with the design based on the escapement principle have been brought out by Sleeper & Hartley, Inc., Worcester, Mass. These machines are specifically designed for accurate, high-speed production of springs. The accuracy and scope of the feed range are outstanding features.

The longer, more accurately measured feeds are made possible by an entirely new holding action which allows more than one revolution of the feed-roll per spring. Feed ranges beyond the standard limitations are accomplished by a feed-cycling arrangement combined with continuous coiling and manual cutter control. Spring production is readily regulated by the variable-speed drive, with dialed speeds and push-button start, stop, and jog control.

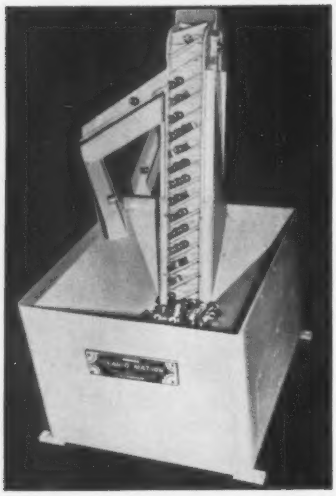
Circle Item 129 on postcard, page 259



Cleveland single-geared, double crank press



Sleeper & Hartley universal spring coiling machine



Automatic parts elevating and feeding unit developed by Gear-O-Mation Division, Michigan Tool Co.

Feeding Device Elevates Parts from Hopper

A device for high-speed, automatic elevating, orienting, and feeding of parts to automated production lines or individual machines has been developed by the Gear-O-Mation Division, Michigan Tool Co., Detroit, Mich. This device uses a combination feeding unit to handle parts that roll or slide, such as gears, cylinders, and spiders. Although custom-made to suit a specific job, the unit is assembled from standard components.

In operation, parts are conveyor-fed or truck-dumped into the hopper section of the unit. From there, they are scooped onto slanted shelves for elevating and feeding to a distribution system. When elevated, properly positioned parts roll through, while improperly positioned parts are chuted back to the hopper. Before passing into the main distribution system, parts from the elevator are again checked as to orientation by being passed over a narrowed track. If not "in line" they drop off and are returned to the hopper. The unit is driven by an enclosed, 1/2-hp motor and variable-speed transmission unit. Elevator height, capacity, and feeding take-off rate are variable to suit application.

Circle Item 130 on postcard, page 259

Special Double-Acting Thrust Bearing for Gear Reduction Units

The Rollway Bearing Co., Syracuse, N. Y., has brought out a special double-acting thrust bearing (shown at left in illustration) which is designed to withstand extremely heavy thrust loads from either direction. This flat-seat type bearing, with 2-inch bore and 6 3/6-inch outside diameter, consists of center plate, two roller assemblies, two stationary plates, and two rotating inner sleeves. The inner sleeves and center plate are keyed to the pinion shaft to insure position rotation under all conditions.

Machined bronze retainers contain four 1/2-inch diameter rollers in each of sixteen slots. Three rollers are 1/2 inch long; the fourth, 3/8-inch in length, is staggered to equalize distribution of wear. Thrust capacity of DT type bearing is 17,550 pounds at 750 rpm.

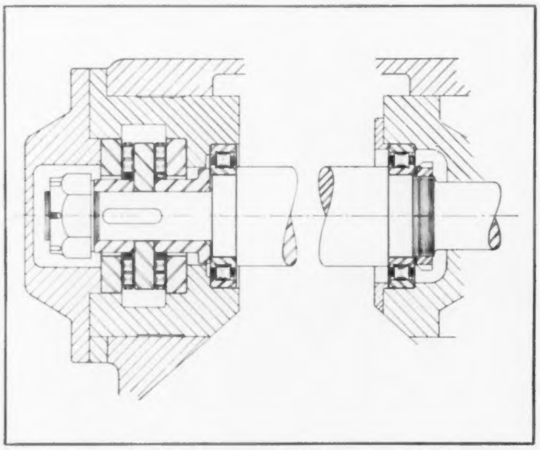
The right-hand end of inner sleeve is extended and heightened to contact rotating inner race of radial bearing (center left). Type ML radial roller bearing with sixteen 5/8- by 5/8-inch crowned rollers has double-flanged inner race and single-flange separable outer race. Radial capacity at 750 rpm is 6300 pounds.

Type MCS radial bearing on input shaft (right) is similar to Type ML in construction and capacity except that separable outer race is straight. Bearing capacity, size, and design may be modified to suit customer specifications.

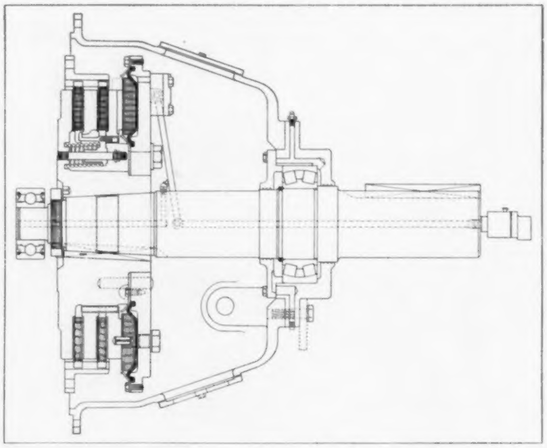
Circle Item 131 on postcard, page 259

Remote-Controlled Friction Power Take-Off

An air-operated, remote-controlled friction power take-off has been announced by the Twin Disc Clutch Co., Racine, Wis. This power take-off is available for use with engines up to 600-hp output in any industrial application where a standard power take-off is used. It combines the Twin Disc Model PO air clutch (replacing a mechanically actuated clutch) with the standard Twin



Rollway special double-acting thrust bearing for gear reduction units



Twin Disc air-operated, remote-controlled friction power take-off

Disc friction power take-off. Engagement and disengagement are accomplished by the turn of an air valve, rather than by a manually operated handle.

Air pressure of 90 to 100 psi will produce all the torque normally needed, but 130 psi air can be utilized if required.

Circle Item 132 on postcard, page 259

Precision Cylindrical Grinder

The Aaron Machinery Co., Inc., New York City, has introduced in this country an Overbeck precision cylindrical grinding machine which is adapted for a wide range of external and internal grinding work. It can grind work of the smallest diameter and has a maximum grinding length of 4 3/4 inches. Components up to 8 5/8 inches in length can be accommodated.

Bearings of the work-head spindle and grinding wheel spindles are adjustable and self-lubricating. Longitudinal movement of the grinding table is effected by a special drive which gives a uniform stroke speed with an accelerated reversal at the end of the stroke. The length of stroke can be adjusted accurately even for very short strokes from 0.004 inch. The longest stroke is 4 3/4 inches.

Different speeds can be selected electrically for the grinding table and the work-head. Thus, interchanging of high duty grinding spindles suitable for external and internal grinding at speeds up to 120,000 rpm presents no difficulty. The infeed of the grinding wheel is automatic and is adjustable from 0.00002 inch per stroke or double stroke. Provision is made for automatic fine adjustment of the cross-feed, with adjustable stop for finish sizing. Electromechanical control is provided for the work-spindle, longitudinal travel, and cross-feed speeds.

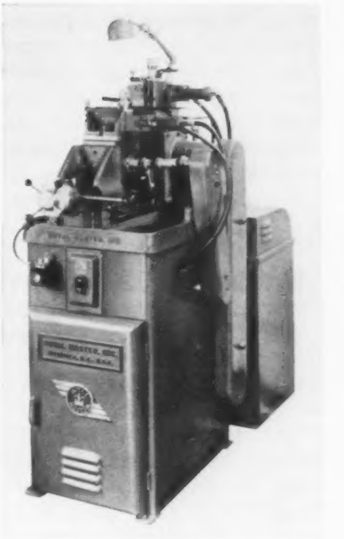
Circle Item 133 on postcard, page 259

Boring Head with Bore and Depth Control

A precision boring head combining positive size bore and depth control has been developed by Briney Mfg. Co., Pontiac, Mich. A patented feature permits adjusting the boring tool to a tolerance of 0.0001 inch without loosening or tightening any screws. The depth adjustment feature facilitates the setting of tools for controlling the bore depth. Tool wear is easily compensated for with this adjustment in both single- and multiple-spindle setups.

Thus, operator can compensate for tool wear and positively maintain bore size and depth control by merely turning the calibrated adjusting collars with a spanner wrench. The whole boring head assembly is sealed against coolant and foreign particle infiltration. This construction permits coolants to be applied to the work directly from the machine spindle through the boring-bar.

Circle Item 134 on postcard, page 259

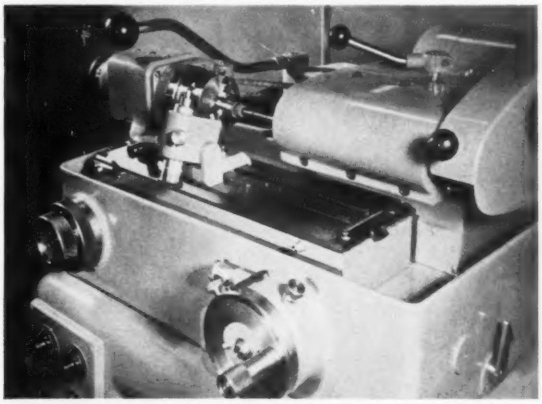


Royal Master centerless grinder

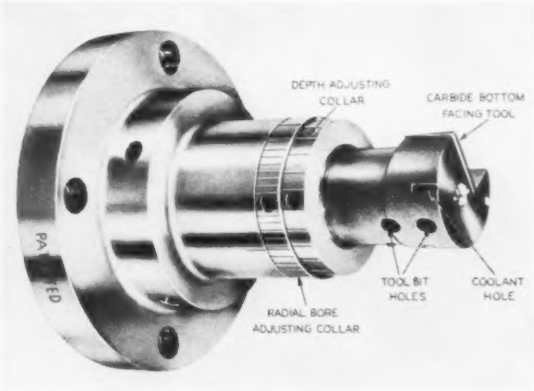
Royal Master Centerless Grinder

Exceptional versatility and accuracy are features claimed for a new TG-12 centerless grinder announced by Royal Master Inc., Riverdale, N. J. This machine is designed for centerless grinding of tungsten carbides, steels, plastics, ceramics, glass, hard rubber, carbon, wood, fiber, cork and nonferrous metals. Tolerances of 0.0002 inch are said to be easily maintained on this machine, and 6 to 8 micro-inch finishes are obtained in either production or single unit processing.

The machine handles work from 0.004 inch to 1 1/2 inches in diameter. It can be used for either



Overbeck precision cylindrical grinder introduced in this country by Aaron Machinery Co., Inc.



Briney boring head designed for bore and depth control adjustments

plunge or through-feed grinding with conversion to either method accomplished in a matter of minutes. A hydraulic system is incorporated in the machine for automatic cycling and wheel dressing.

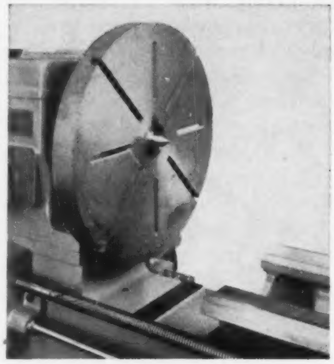
Circle Item 135 on postcard, page 259

Open-Back Inclinable Press

The Johnson Machine & Press Corporation, Elkhart, Ind., has announced an open-back, inclinable press of 150-ton capacity, designated Model No. 150. This press has a box type ram, air clutch, air-actuated spring set brake, 110-volt electrical controls, and conforms to JIC standards. It is equipped with replaceable bronze inserts at the pitman and journal bearings. The standard die space is 22 inches, but a maximum of 39 inches is available on order.

Offered exclusively in the geared type, this press has a standard 6-inch stroke, but up to a 12-inch stroke is available. The flange ram face and box type ram measures 34 by 24 inches. The bolster plate is 50 by 30 by 4 1/2 inches.

Circle Item 136 on postcard, page 259



Nebel block gap lathe with block removed

Nebel Removable Block Gap Lathe

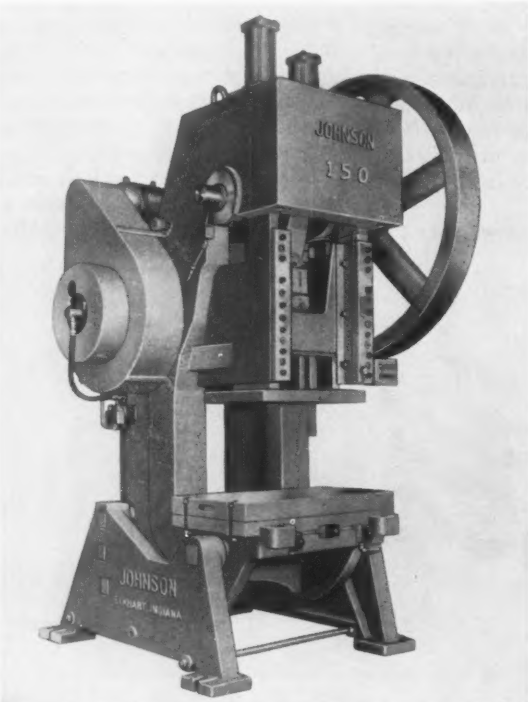
A newly designed block for removable block gap lathes has been announced by the Nebel Machine Tool Corporation, Cincinnati, Ohio. When the block is in place on the bed, a "gap" is intentionally left to accommodate the large faceplate. Thus, the large faceplate can be used for all chucking jobs, making it unnecessary to purchase or use a small faceplate, as was required with earlier models in which the block fitted snugly against the headstock. With the new gap block there is no sacrifice of gap-turning space since the distance from faceplate to end of gap remains unchanged.

Circle Item 137 on postcard, page 259

Automatic Balancing Machine

A fully automatic balancing machine designed to handle a wide range of work, including both rubber and metal automotive parts, has been developed by the Micro-Poise Engineering & Sales Co., Detroit, Mich. Tires, tire and wheel assemblies, brakedrums, and other parts can be balanced on this machine at a rate of better than 300 pieces per hour. It is claimed that automation obtained through the use of the machine has resulted in greater accuracy as well as increased production.

Application of a standard sensing device to the basic Micro-Poise wire-spring pivot movement serves to retain many of the advantages of standard machine



Johnson open-back inclinable press

Micro-Poise automatic balancing machine

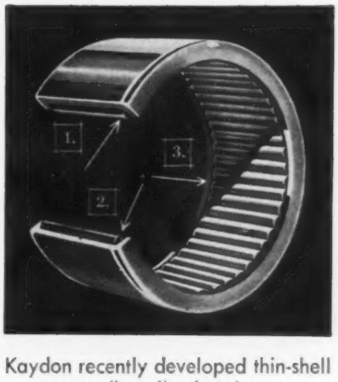
economy. The sensing device transmits information with respect to amount and location of unbalance to electrically controlled correction or marking devices, as required. No special voltage regulation is needed, because normal main voltage fluctuations will not affect the accuracy of the machine.

Circle Item 138 on postcard, page 259

"Beko" Simplified Frame Balancing Machines

The Balance Engineering Co., Chicago, Ill., has announced the "Beko" Model F simplified frame balancing machine as an addition to its line of static and dynamic balancers. The Model F series balancers have weight capacities in various models, ranging from 1/2 ounce to 150 pounds. Magnitudes of unbalance are positively indicated by a large, easy-to-read meter, calibrated directly in terms of the unbalance correction procedure selected. Angular positions are accurately pointed out by a stroboscopic lamp and are readable at a location to either add or remove weight.

Circle Item 139 on postcard, page 259



Kaydon recently developed thin-shell needle roller bearing

Thin-Shell Needle Roller Bearings

The Kaydon Engineering Corporation, Muskegon, Mich., working with the Ford Motor Co., has developed a thin-shell needle roller bearing of new design. This bearing, using "spherical end" rollers, will be assembled in automatic and conventional transmissions, universal joints, steering gears, and clutches. Rollers of this type give maximum capacity in the available space, their rounded ends presenting smooth surface contact with the shell.

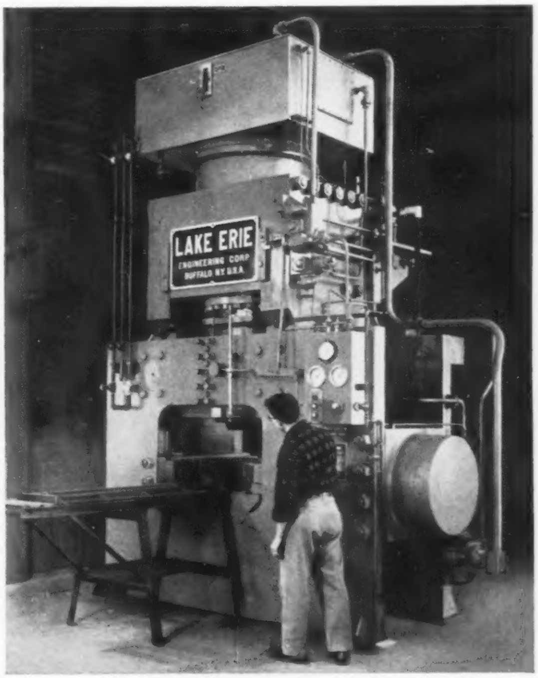
The shells are made of SAE 1010 steel hardened (carbonitrided) to Rockwell 60 C minimum. The rollers are made of SAE 50100 steel also hardened to Rockwell 60 C. These bearings are used with shafts of the same hardness to obtain maximum capacity and life. The two sizes now in production for the Ford and Mercury automatic transmissions are for shaft diameters of 1.0605 and 1.1875 inches with housing bores of 1.3130 and 1.5005 inches, respectively. The housings are 0.500 and 0.625 inch wide.

Circle Item 140 on postcard, page 259

One-Thousand-Ton Briquetting Press

The Lake Erie Machinery Corporation, Buffalo, N. Y., has brought out a 1000-500-ton angle molding type hydraulic press which is a departure from the line of conventional powdered metal presses. Although designed specifically for making 2 1/2- by 2 1/2- by 14-inch zirconium briquettes, the press can also be used for rectangular or square section shapes. The 500-ton horizontal die

Simplified frame balancing machine announced by Balance Engineering Co.



Hydraulic briquetting press brought out by the Lake Erie Machinery Corporation

sealing ram permits the use of split dies and facilitates removal of the briquette. The bed is provided with an opening through which material may be extruded.

The required rigidity is obtained through the front and back plate design. Travel of the top platen is accurately guided by adjustable vee type gib guides at the front and rear of the press. The capacity ratings are: vertical daylight, 22 inches with an 8-inch shut height; horizontal daylight, 28 inches combined with a 6-inch ram stroke; vertical platen size 30 by 34 inches front to back.

Closing speed of the vertical ram is 60 inches per minute, with a 5.4-inch-per-minute pressing speed. The horizontal ram closes and presses at the rate of 9.5 inches per minute. Operational control of both rams is by hand lever. The total weight of the press is 100,000 pounds.

Circle Item 141 on postcard, page 259

Improved Work Feeder with Air Cylinder

The Mead Specialties Co., Chicago, Ill., has announced an improved Model 43 work feeder equipped with a new type single-acting air cylinder. The air cylinder has been redesigned to take a larger diameter return spring.

The oilite bearing surface has been greatly increased to provide more accurate alignment of the ram, smoother travel, and less friction. The mounting surfaces are machined and ground true and parallel, ready to be assembled with other units with a minimum of make-ready.

Circle Item 142 on postcard, page 259

Dearbornaire Multiple-Amplification Contact Air Gage Cartridges

A complete line of multiple-amplification Dearbornaire contact air gage cartridges for interchangeable use on any make or type of air gage instrument is announced by the Air Gage Division, Dearborn Gage Co., Dearborn, Mich.

Guaranteed as to accuracy and linearity, these cartridges are designed for use in checking hard-to-reach surfaces and relationship dimensions involving outside diameters, inside diameters, steps, eccentricity, concentricity, flatness, parallelism, and similar gaging applications. Their interchangeable use through multiple-amplification ranges eliminates using a specific cartridge for a specific tolerance range, and reduces the size of the inventory required with ordinary cartridges.

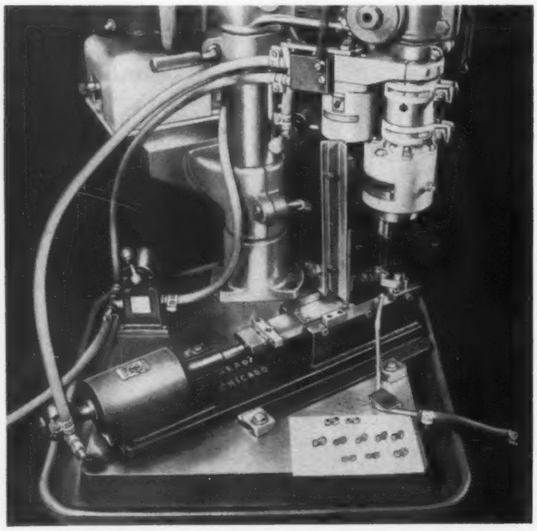
The line includes normal, short normal, and reverse cartridges which can be used interchangeably for 1500, 3000, and 6000 to 1 amplification ranges. In addition, a long-range, low-amplification cartridge for these amplification ratios and a square body type cartridge for simple fixturing applications are also available as standard items.

Circle Item 143 on postcard, page 259

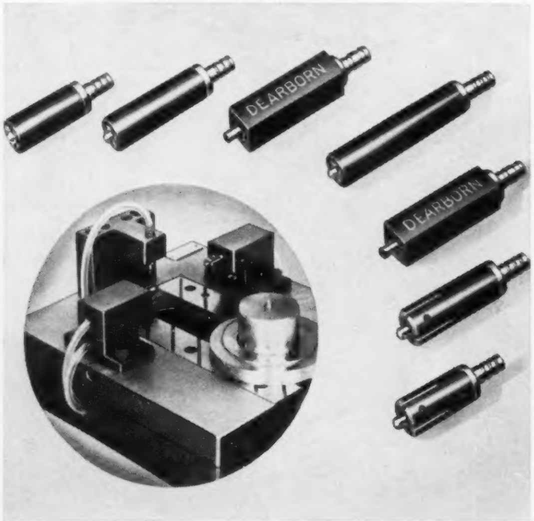
Heller Metal-Cutting Band Saws

A complete new line of "job tempered" metal-cutting band saws has been introduced by the Heller Tool Co., Newcomerstown, Ohio. In "job tempering," steel of carefully controlled analysis is heat-treated and tempered by a unique Heller process that is specially matched to the steel. This development produces blades which are said to offer exceptional cutting performance and long life under the severest working conditions.

The complete line includes both hard edge standard steel and high-speed steel saws. Standard tooth shape is provided for cutting most ferrous and hard, nonferrous materials. Skip tooth blades are furnished for cutting soft metals such as copper and



Mead work feeder combined with "Meadmatic" timer, drill press feed, and other standard Mead units



Multiple-amplification contact air gage cartridges made by Air Gage Division, Dearborn Gage Co.

aluminum, as well as wood, plywood, composition board, and plastics. Hook tooth saws for cutting gummy materials are also included in the line.

Blade widths range from 1/8 to 1 inch. Standard tooth blades are furnished with either regular or wavy set teeth. Skip and hook tooth blades are regular set only. All Heller saws are heat-treated for hardness along the toothed edge only, providing maximum wear resistance for the teeth and leaving the remainder of the blade flexible to withstand the constant bending over the band wheels.

Circle Item 144 on postcard, page 259

Special Automatic Indexing Machine

A special automatic indexing machine for use in the aircraft engine building field has been announced by the Hoefer Mfg. Co. This machine is built around two automatic drill units made by the Hartford Special Machinery Co., Hartford, Conn. Mounted on the horizontal Hartford unit is a two-spindle offset drill head which drills, spot-faces, reams, and hollow mills a group of bosses, two at a time, in the horizontal plane. Since this group of bosses has two different levels, the unit automatically raises for the insertion of a spacer after the lower level of bosses is completed. The unit is again lowered and aligned with the upper level of bosses to complete operation.

The operations are accomplished in three passes. The first pass, drilling and spot-facing, is followed by a tool change, after which the cycle is repeated for the reaming operation. Again, the tools are changed and the cycle repeated for the hollow-milling operation. The sealed, pumpless hydraulic system employed within the units provides the flexibility required for this job.

One additional cycle is made in which the vertical unit drills two 0.078-inch cross holes through the bosses at right angles to the horizontally drilled holes. The work-table is then moved forward for the removal of the piece, leaving the machine ready for a new piece.

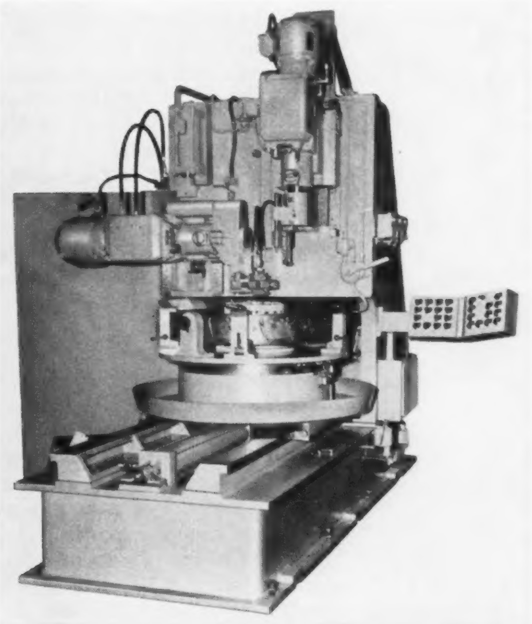
Circle Item 145 on postcard, page 259

Barnes Honing Machine for Small-Diameter Work

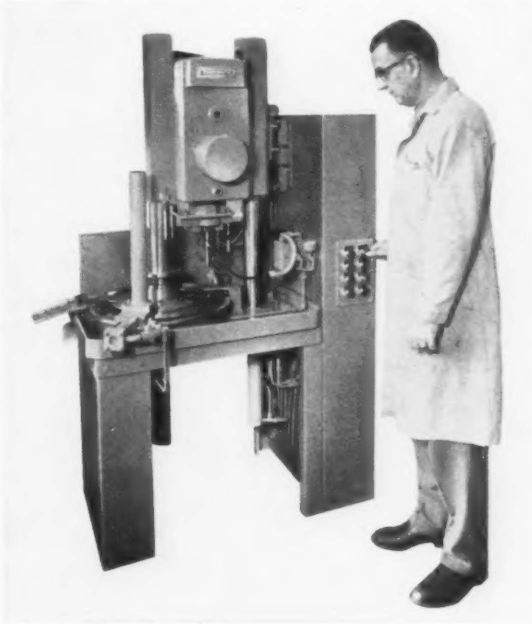
A line of honing machines for small-diameter work has been brought out by the Barnes Drill Co., Rockford, Ill. This line consists of four machines, although there are only two basic models. The Model 10A1 (shown in the illustration) has a 3/8- to 1-inch inside diameter range with a 10-inch swing. The maximum spindle travel is 2 1/2 inches with a 6-inch lift-out stroke. Power is supplied by a 3/4-hp motor. Model 10M1 has the same capacities but is furnished without the automatic attachments. Models 15A2 and 15M2 have a 1/2- to 2-inch inside diameter range with a 15-inch swing. Maximum spindle travel is 6 inches with an 8-inch lift-out stroke. These models are powered by a 2-hp motor.

The machines are designed for manual or automatic honing with mechanical and pneumatic actuation. Compactness, versatility, and simplicity are features of the machines. The floor area required including electrical panel is only 32 by 34 inches to 42 by 63 inches for the largest model.

Versatility is made possible by adding automatic equipment such



Special indexing machine built around two Hartford automatic drill units



Honing machine for small-diameter work built by Barnes Drill Co.

as a rotary indexing table, magazine feed, gages and equipment for bore-to-bore sizing by fluid, plugmatic sizing or time cycle, pneumatic hone expansion with automatic rapid expansion, feed and collapse, postgaging, sorting, and ejection. Provision is made for automatic shut-down for continuous error or when stones are worn.

Circle Item 146 on postcard, page 259

Avey Hydro-Way Drilling Unit and Torque-Matic Attachment

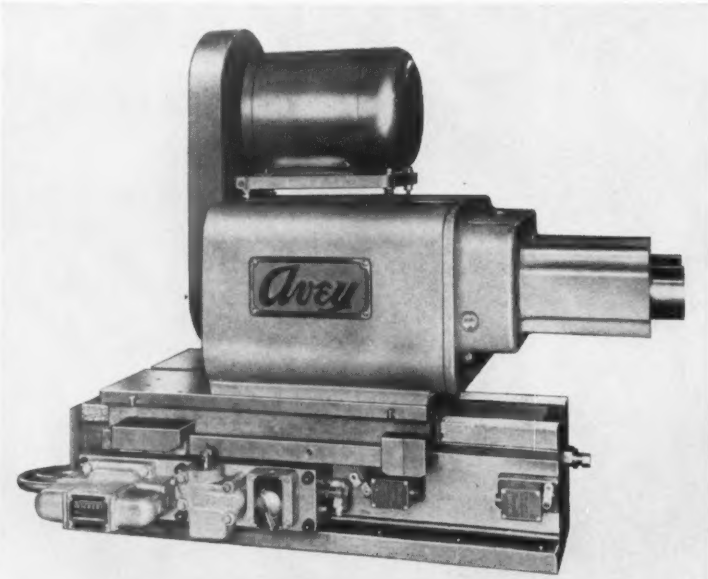
A new "building block" unit for heavy-duty drilling, reaming, spot-facing, boring and counterboring, milling, and chamfering, named No. 4 Hydro-Way, is now in production at the Avey Division, Motch & Merryweather Machinery Co., Cincinnati, Ohio. This unit includes the following features: 5-to 20-hp drive; 12,000-pound maximum thrust; non-metallic ways; hydraulic control panel which simplifies piping; and standard electrical components.

In addition, the unit provides positive depth control; adjustable coarse, fine, and jump feeds; 12-inch travel; simple cutting tool change because of long stroke; and separate pump and tank units to permit operation of additional hydraulic components from one central system.

A new attachment, called Metric Torque-Matic, which eliminates drill breakage during deep-hole drilling, has also been announced. This attachment provides for the exact setting of torque on Avey deep-hole drilling units. The attachment is calibrated so that a number may be selected which corresponds to the desired drill diameter. This assures proper torque on the drill, which is automatically withdrawn any time this torque is exceeded.

Drill diameter charts corresponding with Metric Torque-Matic calibrations may be prepared on any drilling job. The operator simply checks the chart to find the correct setting.

Circle Item 147 on postcard, page 259



Hydro-Way unit equipped with Metric Torque-Matic attachment announced by the Avey Division, Motch & Merryweather Machinery Co.

Red Ring Gear Gaging, Sorting, and Machine Control Unit

Red Ring pedestal type gear gaging, sorting, and machine tool control unit

A Model GRF, Red Ring pedestal type gear gaging, sorting, and machine tool control unit for gear production lines is available from National Broach & Machine Co., Detroit, Mich. The unit can be adapted to check size and helix angle accuracy of spur or helical gears. A model for hobbing machines checks and sorts gears for both size and helix angle accuracy. Another model for gear shapers and shaving machines checks and sorts gears for size accuracy only.

The gaging machine shown is a standardized Red Ring design which consists of a motorized gaging and sorting unit through which the gears are fed, one at a time, from an inclined feed chute. Gears that pass inspection travel through the machine into an inclined exit feed chute.

The gaging unit has a motorized lower master gear and a non-rotating upper master gear through which the production gears are passed for the gaging check. The upper master gear is pivoted in two planes to assure accurate size check without helix angle interference.

Separate electrical controls for the unit can be mounted at any desired location. Reject pans for gears that do not pass size or helix angle specifications are under the gaging machine. The unit automatically shuts down the machine after a predetermined number of reject parts are detected.

Circle Item 148 on postcard, page 259

(This section continued on page 234)

NOW — new design efficiency that delivers up to 80% faster production

BROWN & SHARPE AUTOMATICS for this FULL RANGE OF WORK SIZES

Now, right up the line, all Brown & Sharpe Automatic Screw Machines have the new design features that boost over-all efficiency 33⅓% higher . . . production rates up to 80% faster than in models replaced.

up to ½"

No. 00 takes stock to ½" dia.

Spindle speed range 7200 to 34 rpm
Turns any length to 1" . . . with optional equipment, to 1½"
Ratios, high to low speeds 2.3:1 to 16:1

up to ¾"

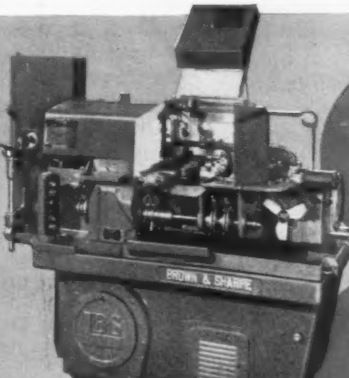
up to 1¼"

up to 1½"

No. 2 – in THREE SIZES

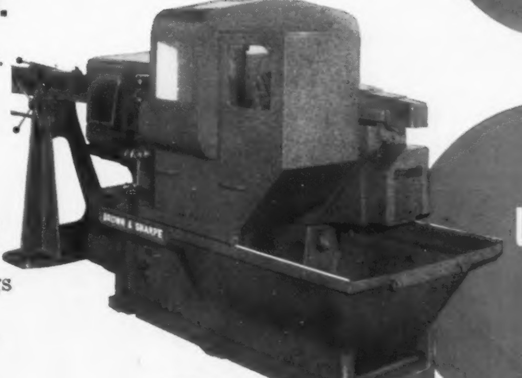
Take stock to	¾" dia.	1¼" dia.	1½" dia.
Spindle speed range	5050 to 25 rpm	3500 to 17 rpm	2450 to 17 rpm

Turn any length to 2½" . . . with optional equipment, to 3½"
Ratios, high to low speed 2.2:1 to 15:1



No. 4 takes stock to 2" dia.

With outside feed, takes stock up to 2⅜" dia.
Spindle speed range 1965 to 17 rpm
Turns any length to 5"
Ratios, high to low speeds 2.2:1 to 13:1



up to 2"

Get complete information. Compare for adaptability . . . precision . . . ease of set-up. Figure the big savings you could make, and you'll see why so many buyers say, "They pay for themselves, in record time." Brown & Sharpe Mfg. Co., Providence, R. I.

BS

The home of PRECISION CENTER **Brown & Sharpe**

MILLING, GRINDING, AND SCREW MACHINES • CUTTERS
MACHINE TOOL ACCESSORIES • PRECISION TOOLS • PUMPS

For more information fill in page number on Inquiry Card, on page 259

Pratt & Whitney Specialty Gages

The Pratt & Whitney Co., Inc., West Hartford, Conn., announced six new products brought out by its gage division: a "Dual-Aire Air-O-Limit" comparator for closer control of high-precision production; an automatic radial-play gage which has a capacity of 1200 pieces per hour and is said to enable ball bearing manufacturers to maintain much more rigid quality control, as well as apply 100 per cent inspection faster and at less cost; a sigmatic multi-dimension automatic gaging machine, which solves the basic problem of 100 per cent inspection of parts requiring the accurate checking of several dimensions (will check up to fifty dimensions simultaneously with extreme speed and accuracy); a digital read-out supermicrometer to reduce to a minimum the element of human error in the most carefully planned quality control system; "Electrolimit" supermicrometer, which is particularly useful at the machine on lapping, fine machining, grinding, and other precision work (now equipped with an Electrolimit tailstock and high-magnification instrument cabinet); and "Tri-Roll" thread comparator, which duplicates the three-wire thread measurement method.

"Dual-Aire Air-O-Limit" comparator made by Pratt & Whitney Co., Inc.

The "Dual-Aire Air-O-Limit" comparator illustrated was one of the six new specialty gages which were displayed for the first time at the annual convention and exposition of the American Society for Quality Control at Detroit.

Circle Item 149 on postcard, page 259

Machines for Bonding Liners to Automotive Parts

Equipment developed recently by the Modern Industrial Engineering Co., Detroit, Mich., for rapid bonding of liners to automatic transmission parts includes a line of multi-station rotary bonding machines such as the twenty-station model shown in Fig. 1 and a compainon preliminary cold-assembling press, Fig. 2.

Each station completes a part in six minutes for a production rate of 200 parts an hour. The special cold-assembling press shown in Fig. 2 locates, positions, and preliminarily bonds a cone-shaped molded liner to the conical surface of a piston ready for the final bonding operation on the machine shown in Fig. 1.

In the cold-assembling operation, the piston and liner, pretreated by using oven-dried cement and a solvent activator, are placed on the lower platen of one station of the press, Fig. 2, and finger-positioned together. Both parts are held by a retaining collar. The automatic cycle then takes over, with the press ram being lowered against an expandable neoprene mandrel to axially produce pressure about the entire liner area. This action provides positive location and avoids any danger of securing the liner in an elliptoid position. A holding pressure of about 400 psi is then applied by the ram and maintained for a predetermined and variably controlled cycle. Ram return is automatic. The operator loads one station while the other station is in operation.

The final bonding machines are offered in a capacity range of from single and multi-station stationary types and up to forty-station rotary types for permanently bonding liners (using a commercial adhesive) to either internal or external surfaces.

Circle Item 150 on postcard, page 259

(This section continued on page 238)

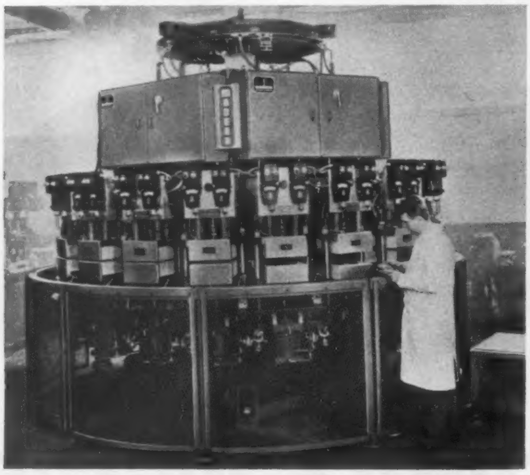


Fig. 1. Twenty-station automatic bonding machine developed by the Modern Industrial Engineering Co.

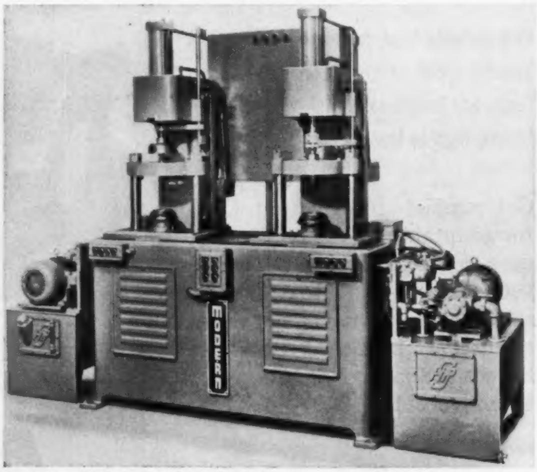
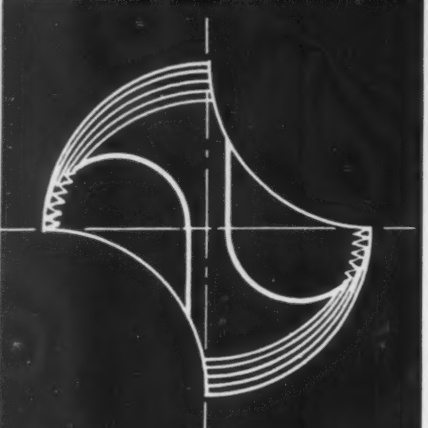


Fig. 2. Special cold-assembling press—companion equipment for bonding machine shown in Fig. 1.



Chips flow freely, since chip driver contours are always of exact size, shape, and position.

BALANCED ACTION TAPS
cut clean—always!

When you know that a tap has been manufactured with great care and skill—you're assured of closely controlled hole size and long tool life. Only Winter makes taps with Balanced Action. They give clean-cutting performance—*always.*

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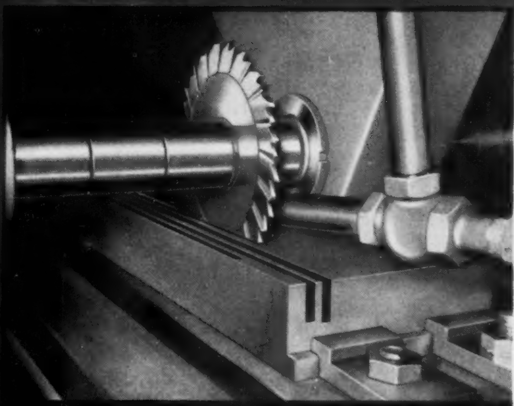
Division of National Twist Drill & Tool Co.

WINTER



The search that never ends

Finding the best way to do a deep-slotting job in the National research laboratory.

National will have the right one

National's complete line of tools can save you time and tool-life. For instance—just tell National about your sawing or slotting job. You'll get a tool that is sized, styled, and designed to do the best job.

NATIONAL TWIST DRILL AND TOOL CO.

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TWIST DRILLS • REAMERS • COUNTERBORES • MILLING CUTTERS • END MILLS • HOBS • CARBIDE AND SPECIAL TOOLS

Reliance Right-Angle Gear-Motor, Variable-Speed Electronic Drive and Reeves Motodrives

A line of space-saving, right-angle gear-motors with heavy load-carrying and shock-absorbing qualities for industrial applications has been introduced by the Reliance Electric & Engineering Co., Cleveland, Ohio. These gear-motors, Fig. 1, in 1- to 10-hp sizes for continuous-duty applications, and in 1- to 30-hp sizes for intermittent duty are now available with such features as horizontal or vertical mountings, conventional double shaft, and hollow shaft to fit all types of applications calling for reduced speeds. The gear-motors can be supplied with either an alternating- or direct-current speed or duty rating, and any standard type of enclosure—protected-open, totally enclosed, or explosion-proof. The footless motor, with D-flange and modified shaft, is bolted directly to a flange that is cast with the gear housing.

A redesigned Reliance VS Jr. variable-speed electronic drive, not illustrated, was also announced recently. This drive with its maximum size boosted from 3 hp up to 4 hp gives wider application coverage than preceding models. The compact, packaged electronic drive consists of a rectified-power control panel, an operator's station, and a variable-speed drive motor. Available in 220- and 440-volt models in sizes from 3/4 through 4 hp, it gives wide-range adjustable speed.

At the twist of a simple rheostat control, this drive will operate from a speed as low as 23 rpm for intermittent setup duty, or up to 2300 rpm for high-speed production. It can be plugged into the alternating-current power line of any plant (an autotransformer is available for use on 110-, 380-, or 550-volt power sources) and it instantly produces adjustable drive speeds requiring no motor-generator sets, direct-current lines, or mechanical devices.

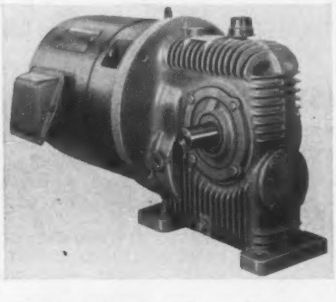


Fig. 1. Reliance right-angle gear-motor designed for heavy loads

The Reeves Vari-Speed Motodrive, Fig. 2, is another product being introduced. Improved operating efficiency and extended ratios of speed variation are features of this new model. Each size is available in standard assemblies tailored to fit a wide range of space requirements.

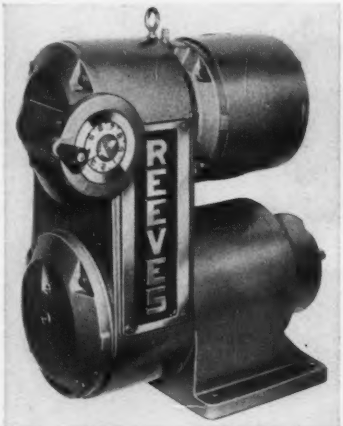


Fig. 2. Reeves Vari-Speed Motodrive

Circle Item 151 on postcard, page 259

Keyless Drill Chucks

The Jacobs Mfg. Co., West Hartford, Conn., exclusive distributor in the United States and Canada for the Albrecht keyless drill chucks, has announced that its dealers throughout this country and Canada will have available eleven heavy-duty models of the Albrecht keyless drill chucks with capacities ranging from 1/8 to 5/8 inch and a special small drill chuck with a capacity of from 0 to 1/16 inch for small drill presses operating at high spindle speeds. The company will also carry a substantial stock of repair and replacement parts at its West Hartford plant and has set up a special service department for prompt repairs on Albrecht chucks.

Albrecht keyless drill chuck distributed by the Jacobs Mfg. Co.

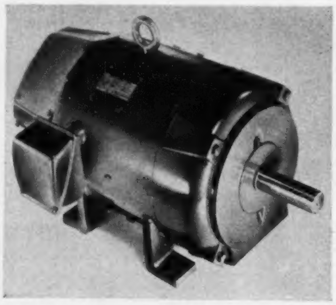
These chucks are designed for use on the finest precision drilling machinery where close-tolerance drilling is essential. Working parts are of alloy steel, expertly hardened, and the keyless construction permits very rapid drill changes. The chucks are furnished with standard Jacobs taper backs.

Circle Item 152 on postcard, page 259

Westinghouse Industrial Direct-Current Motors and Generators

A new ventilating system, improved commutating ability, and reduced armature inertia are said to work together for greater dy-

(Continued on page 244)



Direct-current "Life-Line" motor introduced by Westinghouse Electric Co.

surest thing in measuring–

There's never an argument when it comes to precision measuring tools. Just specify STARRETT and you'll please everyone in the shop — from the tool crib supervisor to the rawest apprentice.

But why stop with measuring tools when there are so many opportunities to get the same quality and dependability in so many other Starrett products? Did you know, for example, that Starrett makes the world's most complete line of dial indicators and dial gages? Or that Starrett is among the largest producers of hacksaws, hole saws, band saws and band knives? Or that Starrett makes precision ground die and flat stock in over 1000 sizes?

Your Industrial Supply Distributor stocks the complete Starrett line. He can give you prompt, dependable service to match the quality and dependability of Starrett products. It pays in so many ways to specify *Starrett.*

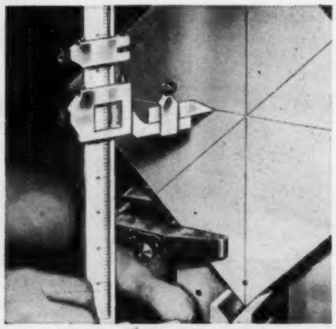
NEW CATALOG No. 27

Shows the complete Starrett line. Ask your Industrial Supply Distributor or write for free copy. Address Dept. D, The L. S. Starrett Company, Athol, Massachusetts, U.S.A.

Starrett

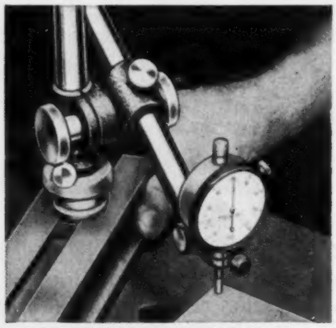
SINCE 1880
WORLD'S GREATEST TOOLMAKERS

MECHANICS' HAND MEASURING TOOLS AND PRECISION INSTRUMENTS
DIAL INDICATORS • STEEL TAPES • PRECISION GROUND FLAT STOCK
HACKSAWS • HOLE SAWS • BAND SAWS • BAND KNIVES



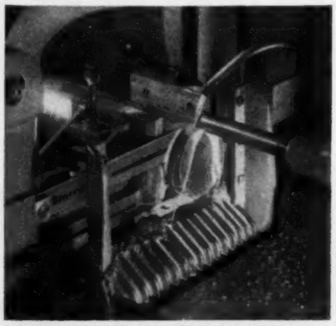
HAND MEASURING TOOLS AND PRECISION INSTRUMENTS

The name Starrett on a tool guarantees accuracy, fine workmanship and complete dependability.



DIAL INDICATORS AND GAGES

Standard for quality and dependability— a complete line for every gaging or production inspection application.



HACKSAWS, BAND SAWS, BAND KNIVES

Precision made and production proved for top performance, uniformity and maximum cutting economy.

PRECISION GROUND DIE STOCK AND FLAT STOCK

Now over 1000 sizes — air, oil, oil and water and water hardening types. "Just lay it out and saw it out."

For more information fill in page number on Inquiry Card, on page 259

AMERICAN STANDARD FORMULAS FOR NUTS—2

TYPE OF NUT	WIDTH ACROSS FLATS		THICKNESS OF NUT	
	BASIC[1]	TOLERANCE (Minus)	NOMINAL[2]	TOLERANCE (Plus or Minus)
Heavy Hexagon Heavy Square	$1\frac{1}{2}D + \frac{1}{8}$	0.050D	D	Plus tolerance only 0.016D + 0.012 Minus tolerance adjusted so that minimum thickness is equal to minimum thickness of heavy semi-finished hexagon nut.
Heavy Hexagon-Jam	$1\frac{1}{2}D + \frac{1}{8}$	0.050D	$\frac{1}{4}$ to $1\frac{1}{8}$: $\frac{1}{2}D + \frac{1}{16}$ $1\frac{1}{4}$ to $2\frac{1}{4}$: $\frac{1}{2}D + \frac{1}{8}$ $2\frac{1}{2}$ to 4: $\frac{1}{2}D + \frac{1}{4}$	Plus tolerance only 0.016D + 0.012 Minus tolerance adjusted so that minimum thickness is equal to minimum thickness of heavy semi-finished hexagon-jam nut.
Heavy Semi-Finished Hexagon Heavy Semi-Finished Hexagon Slotted	$1\frac{1}{2}D + \frac{1}{8}$	0.050D	$\frac{1}{4}$ to $1\frac{1}{8}$: $D - \frac{1}{64}$ $1\frac{1}{4}$ to 2: $D - \frac{1}{32}$ $2\frac{1}{4}$ to 3: $D - \frac{3}{64}$ $3\frac{1}{4}$ to 4: $D - \frac{1}{16}$	0.016D + 0.012
Heavy Semi-Finished Hexagon-Jam	$1\frac{1}{2}D + \frac{1}{8}$	0.050D	$\frac{1}{4}$ to $1\frac{1}{8}$: $\frac{1}{2}D + \frac{3}{64}$ $1\frac{1}{4}$ to 2: $\frac{1}{2}D + \frac{3}{32}$ $2\frac{1}{4}$: $\frac{1}{2}D + \frac{9}{64}$ $2\frac{1}{2}$ to 3: $\frac{1}{2}D + \frac{13}{64}$ $3\frac{1}{4}$ to 4: $\frac{1}{2}D + \frac{3}{16}$	0.016D + 0.012

All dimensions given in inches.
[1] Adjusted to sixteenths.
[2] Adjusted to fractions.
D = Nominal nut size.
W = Width across flats.

WIDTH ACROSS CORNERS

HEXAGON

For all hexagon nuts, max. width across corners equals 1.1547 × W (max.) and min. width across corners equals 1.14 × W (min.)

SQUARE

For all square nuts, max. width across corners equals 1.4142 × W (max.) and min. width across corners equals 1.373 × W (min.)

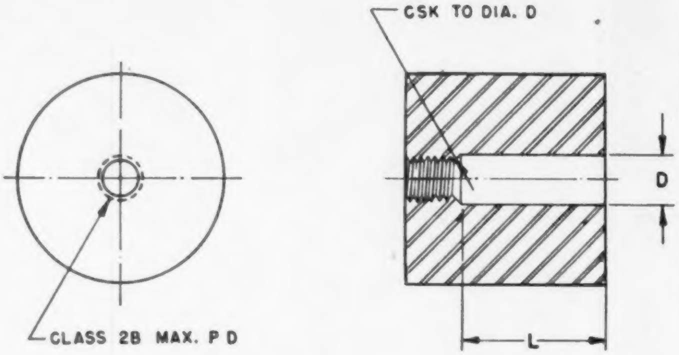
Extracted from American Standard Square and Hexagon Bolts and Nuts (ASA B18.2-1955), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

MACHINERY'S DATA SHEET

AMERICAN STANDARD THREAD-RUNOUT SLEEVE GAGES

Sleeve gages capable of checking the thread eccentricity and bow of shank on Finished Hexagon bolts are illustrated in the following cuts. The optional construction permits the use of different length sleeves to accommodate different bolt lengths.

Ring gage A in the optional construction is centered in position on sleeve B by means of positioning plug E and is secured in position by means of attachment screws C. The ring gage is also set to maximum P.D. by positioning plug E. The internal diameter D of the sleeve equals the nominal diameter of the bolt plus runout allowance. The sleeve should extend beyond the last thread of the bolt to be inspected but should not exceed 3 in. in length. Failure of the bolt to enter the ring gage or interference between the sleeve and bolt while engaging the ring gage indicates excessive thread runout.

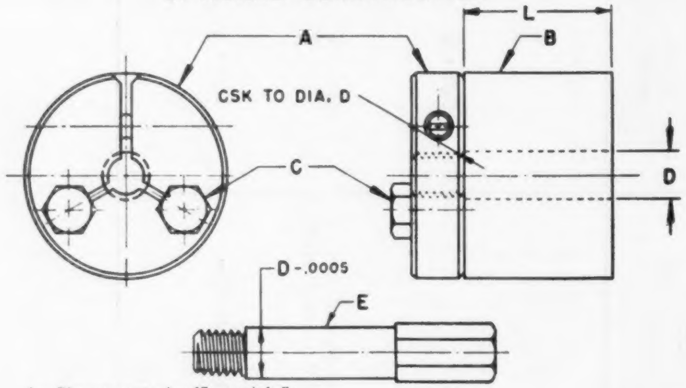


D — Max. Dia. of Screw Plus Clearance Allowance

L — Length of Screw Minus One Screw Diameter

SHALL BE HARDENED

OPTIONAL CONSTRUCTION



A — Ring gage set to class 2B max. pitch dia.

B — Sleeve

C — Attachment screws

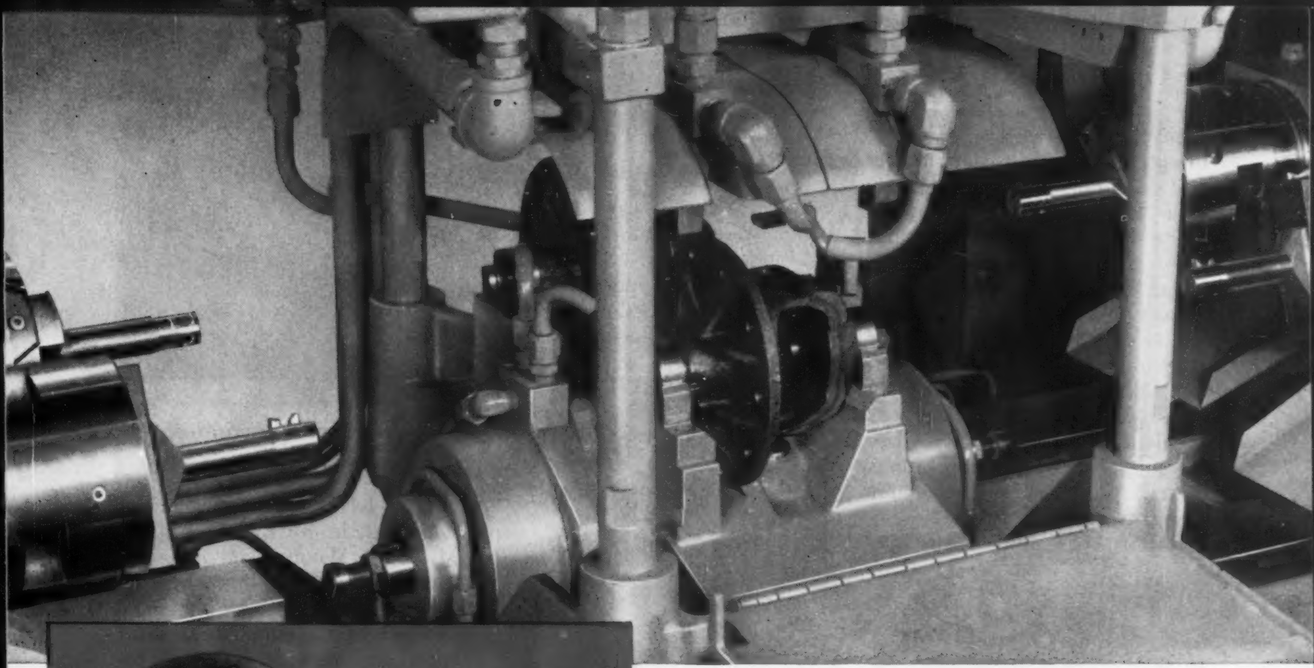
D — Dia. of hole in sleeve = max. screw dia. plus clearance allowance

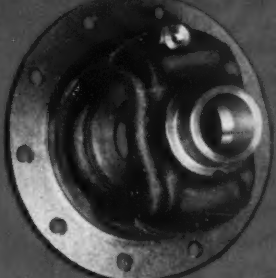
E — Positioning and setting plug, thds.- class 2B max. PD, for adjusting ring gage and centering sleeve

L — Length of sleeve = length of screw minus one screw diameter

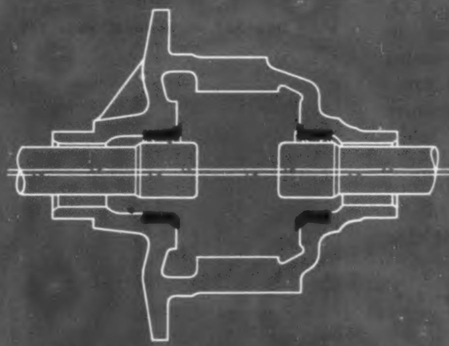
SHALL BE HARDENED

Extracted from American Standard Square and Hexagon Bolts and Nuts (ASA B18.2-1955), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

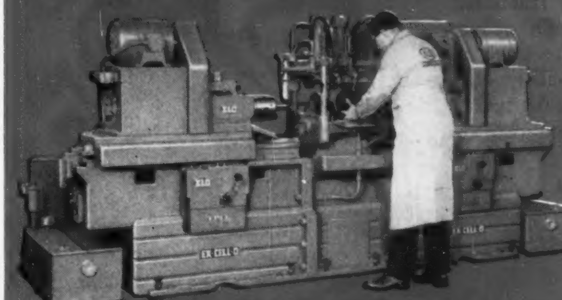




Above, close-up of parts in fixture. Overhead air clamps in position for loading and unloading. Part shown at left.



Internal boring and chamfering cuts indicated by black lines. Tolerances are held to ± .0005".



Ex-Cell-O Two-Way Precision Boring Machine ups production, increases accuracy.

XLO EX-CELL-O FOR PRECISION

Increases Production, Keeps Accuracy

Back-bores and Chamfers Differential Cases

If you want to increase production, yet maintain .0005" accuracy, get an Ex-Cell-O Two-Way Precision Boring Machine. That's the opinion of an automobile manufacturer.

Right now this machine is performing back-boring and chamfering operations inside steel automotive differential cases for this company. Boring bars enter the case on the center line of the bores, then move 5/32" off center, perform the cutting operations, then withdraw after returning to the center line. Two cases are machined at the same time.

Ex-Cell-O Way Machines perform as one, two, three, and four-way assemblies with exceptional versatility.

These machines adapt smoothly into automated lines, too. See your Ex-Cell-O representative or write Ex-Cell-O, Detroit.

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

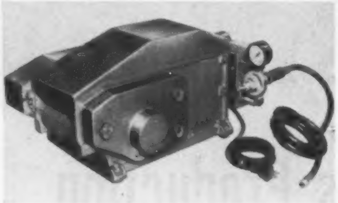
Machinery Division

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

57-24

namic response in a new line of direct-current industrial motors and generators known as the Life-Line "H" series announced by the motor department of the Westinghouse Electric Corporation, Pittsburgh, Pa. These motors and generators are designed to be equally effective as basic prime movers or as elements of highly complex automatic production systems. They have dripproof enclosures as standard and bear NEMA Class B ratings; they span motor ratings from 1 to 150 hp and generator ratings from 3/4 to 100 kw.

Circle Item 153 on postcard, page 259



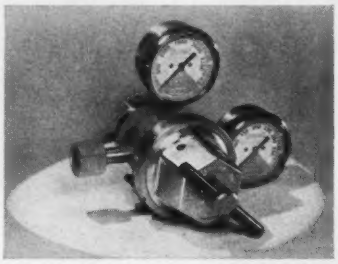
Automatic Air-Operated Tape Dispensers

One of a series (four models) of fully automatic, air-operated tape dispensers for industry brought out by Air Fixtures, Inc., North Manchester, Ind. This dispenser has no push-buttons, levers, or foot pedals. When the operator removes a length of tape, a micro switch automatically sets in motion the next delivery cycle. Available for all types of pressure-sensitive tape in widths up to 4 inches and lengths up to 21 inches.

Circle Item 154 on postcard, page 259

Heavy-Duty Carbon Dioxide Regulator

Oxweld R-68-400 heavy-duty carbon dioxide regulator introduced by Linde Company, Division of Union Carbide Corporation, New York City. Designed for use on carbon dioxide cylinders or mani-



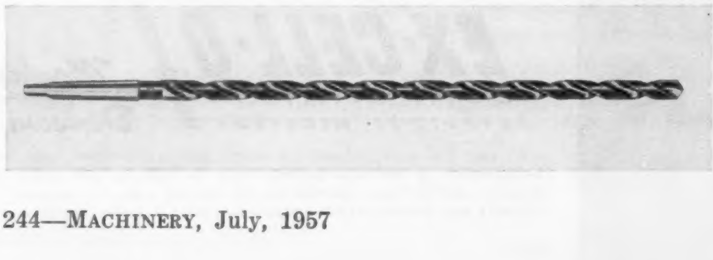
folds, the new regulator is said to have the largest capacity and widest work range of any CO_2 regulator now available. Effective operation is possible at any delivery pressure up to 200 psi. These features, combined with extremely sensitive control, adapt the regulator to a wide range of applications from control of delivery rates for pressurizing premix containers to regulating CO_2 in core-molding operations in foundries. The regulator operates on a two-stage principle of pressure reduction. Cylinder pressure is first reduced to a steady, intermediate stage and then to the desired delivery pressure. A porous filter in the inlet connection blocks and absorbs any dirt or dust that might affect valve seating.

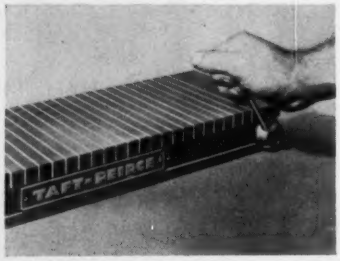
Circle Item 155 on postcard, page 259

Whitman & Barnes Extra-Length Drills

One of a complete line of high-speed steel extra-length drills announced by Whitman & Barnes, Plymouth, Mich. These drills are designed for operations where inaccessibility is a problem or for drilling extremely deep holes. Either straight or taper shank styles in wire gage or fractional sizes are available. Diameters range from No. 52 wire gage to 1 1/2 inches, and over-all lengths to 23 1/2 inches. Larger diameters and longer lengths can also be furnished on order.

Circle Item 156 on postcard, page 259

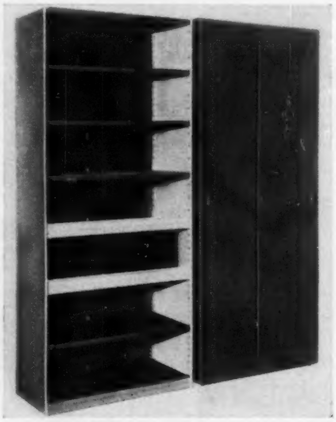




Taft-Peirce Permanent Magnet Chuck

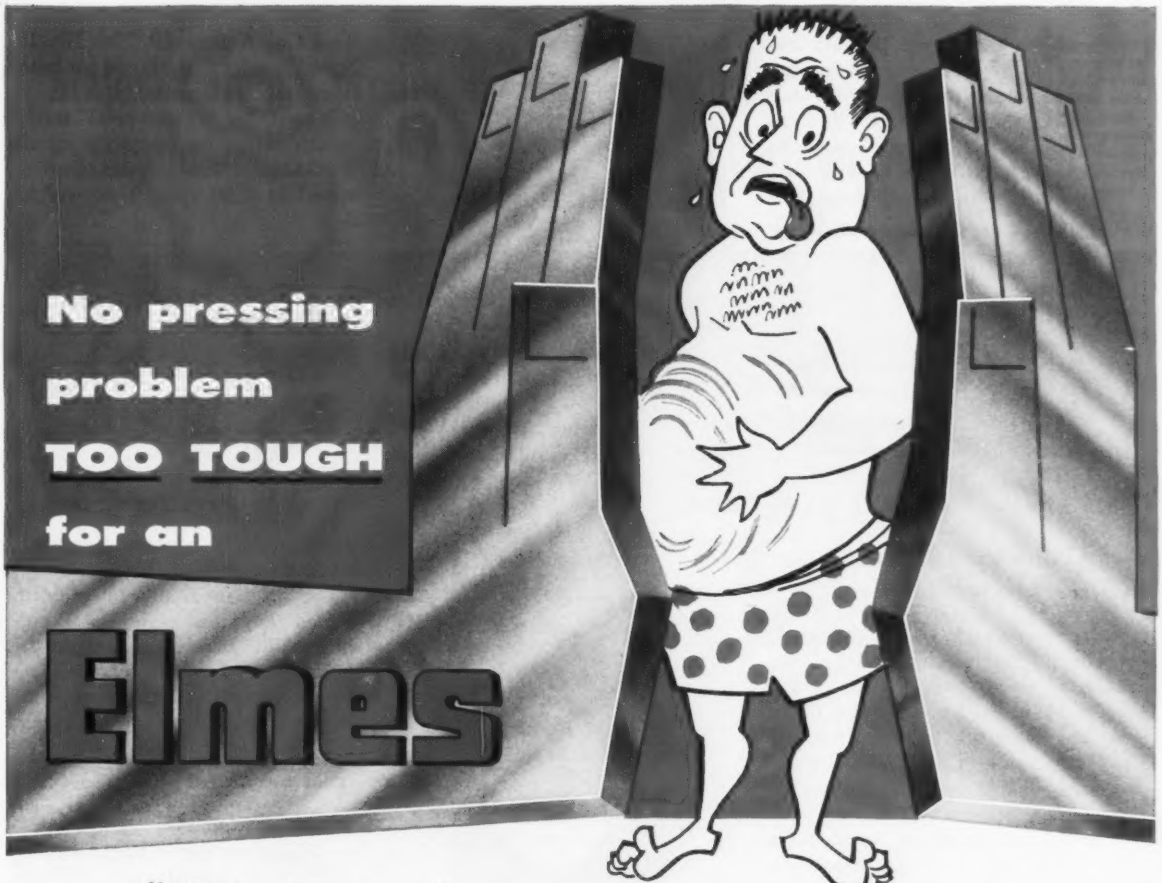
Model 824 permanent magnet chuck made by the Taft-Peirce Mfg. Co., Woonsocket, R.I., features 100 per cent all-over holding power. Special Alnico V-chuck design is said to eliminate all dead spots and provide full edge-to-edge usable surface. The new style faceplate uses a special epoxy resin, non-magnetic separator material which provides unusual faceplate stability and makes the chuck 27 per cent lighter. The chuck is only 2 7/18 inches high, has a work surface 8 by 24 inches, a magnetic surface area of 168 square inches; and weighs only 110 pounds.

Circle Item 157 on postca d, page 259



"Erectomatic" Steel Shelving

Hallowell "Erectomatic" steel shelving that can be erected in about half the time required to assemble conventional units. This shelving has been introduced by the Standard Pressed Steel Co., Jenkintown, Pa. It features a locking device which holds each shelf

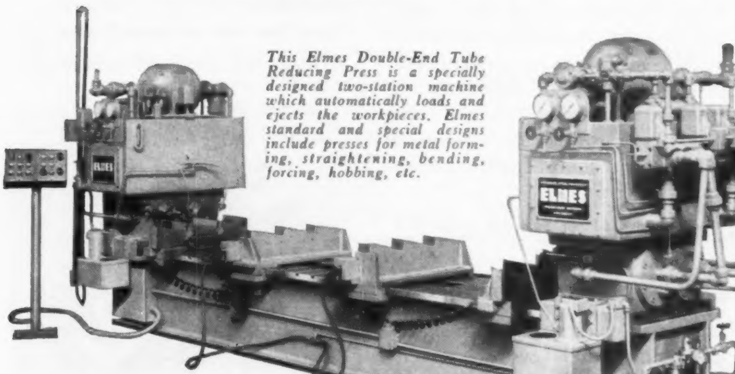


"Job-Fitted" HYDRAULIC PRESS

Is a "troublesome shape" getting you in a squeeze? Tough production problems involving unusual shapes are often "old hat" to Elmes engineers—situations made to order for Elmes ingenuity in helping with consultation and recommendations.

Sometimes a standard design Elmes® Press, or a simple adaptation of it, will handle the customer's requirements. Sometimes the work to be performed involves development of a special custom-built press. But, *whatever it takes,* Elmes is equipped to provide *the right press for the job!*

It just makes sense to take advantage of the best of someone else's experience—particularly when it is backed up by more than 60 years of leadership in specialized hydraulic service. Whatever your pressing problem, it will pay you to call in Elmes. See your nearby authorized Elmes distributor, or write to us direct.



This Elmes Double-End Tube Reducing Press is a specially designed two-station machine which automatically loads and ejects the workpieces. Elmes standard and special designs include presses for metal forming, straightening, bending, forcing, hobbing, etc.

American Steel Foundries

Elmes

ENGINEERING DIVISION

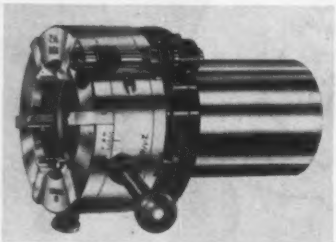
1162 Tennessee Ave., Cincinnati 29, Ohio

• METAL-WORKING PRESSES • ACCUMULATORS
• PUMPS • PLASTICS MOLDING PRESSES

For more information fill in page number on Inquiry Card, on page 259

firmly in place, yet permits any shelf to be removed or repositioned in a matter of seconds without the use of tools. The illustration shows a closed shelving unit without doors and a unit equipped with sliding doors.

Circle Item 158 on postcard, page 259



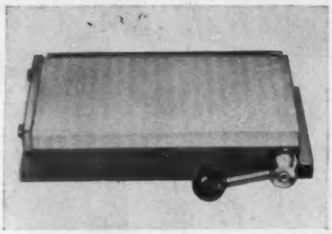
Geometric Die-Head with Convertible Trip

Convertible trip die-head brought out by the Geometric Tool Co. Division, Greenfield Tap & Die Corporation, New Haven, Conn. This die-head incorporates features of the "DSA" die-head and is especially designed for use on the No. 4 Brown & Sharpe automatic. The shank, as shown in the illustration, is of maximum size and is altered to the 1 3/4-inch diameter size when used on the Brown & Sharpe No. 4 machine. The 2 1/4-inch "DSA" convertible die-head will take the full capacity of the Brown & Sharpe No. 4 screw machine. This 2 1/4-inch size is equipped with both an outside trip for short length and fine-pitch shoulder threading and a pull-off trip for longer threads, providing ample chaser engagement for tripping. Conversion from one trip to the other is quickly and easily accomplished. The alignment shank feature is standard on all "DSA" die-heads.

Circle Item 159 on postcard, page 259

Walker Permanent Magnetic Chuck

Multi-pole, fine-division, permanent magnetic chuck of line introduced by the O. S. Walker Co., Inc., Worcester, Mass. This chuck has fine pole divisions with characteristics developed to equal those of electromagnetic chucks. This desired quality is said to



have been obtained largely by the use of a ceramic magnetic material never before employed in this field. The chuck is being made in three sizes—6 by 10 1/2 inches, 6 by 12 1/2 inches, 6 by 18 1/2 inches, with heights of 2 1/8, 2 1/8, and 2 3/8 inches, respectively.

Circle Item 160 on postcard, page 259

Simonds DA Borolon Abrasive Wheel

High - speed, resinoid - bonded snagging wheel made with improved type aluminum oxide abrasive by the Simonds Abrasive Co., Philadelphia, Pa., for use in steel mills and foundries. The fused crystalline aluminum oxide, has a small crystalline structure within each cutting particle that provides greater resistance to fracture and, at the same time, presents a continuous succession of more and sharper cutting edges on the wheel face.

Circle Item 161 on postcard, page 259

Thor Portable Sander

Universal electric portable sander combining high work capacity with light weight, recently added to the line of orbital "Speed-Sander" made by the Thor Power Tool Co., Aurora, Ill. This No. 16 Speed Sander is designed for both home and industrial use. It is powered by a universal series wound motor for operation on alternating or direct current at a speed at 6200 rpm. Tool weighs

approximately 5 pounds and has a sanding area 4 1/2 by 5 1/8 inches. It is available in kit form, which includes eighteen aluminum-oxide abrasive sheet covers, a permanent type template, two free abrasive felt pads, neoprene contour pad, lamb's wool cover, and fitted steel carrying case.

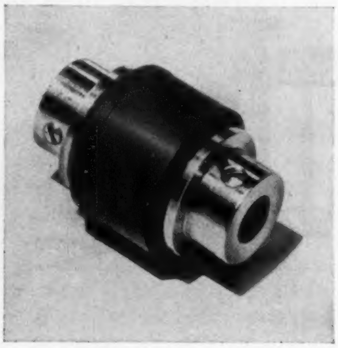
Circle Item 162 on postcard, page 259

Pic Precision Flexible Coupling

One of a complete line of precision flexible couplings made by the Pic Design Corporation, East Rockaway, N.Y. These couplings are made of No. 303 stainless-steel hubs, precision bored to 0.0002 inch tolerance, and come in three shaft sizes—1/8-, 3/16-, and 1/4-inch diameters. The centers are of molded neoprene. The couplings control shaft-to-shaft misalignment and isolate torsional vibration.

Circle Item 163 on postcard, page 259

(This section continued on page 248)



Major chemical producer meters flow of catalytic agents with Cleveland Speed Variator

A chemical research worker adjusts the manual control knob on the Cleveland Speed Variator to set the metering speed. Various types of regulating mechanisms can be mounted on the Variator to provide automatic adjustment by remote control.

HOW IT WORKS

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view, left).

IN the research department of a major chemical plant, catalytic agents are metered and their flow varied with precision accuracy. This control is exercised with a Cleveland Speed Variator.

A ¼-horsepower electric motor is connected to the Cleveland Speed Variator driving a pump through a 25-1 speed reducer. Being infinitely variable, the Variator gives stepless speeds over its full 9:1 range—from ⅓ to 3 times input speed. Pumping speed can be varied from 207 to 23 rpm. This provides the necessary speed range for metering the various types of catalytic agents.

Available in eighteen standard types and sizes, the Cleveland Speed Variator offers these major advantages: 1. An extremely compact unit; 2. Almost any input speed up to 1800 rpm—clockwise or counterclockwise; 3. Constant horsepower output over a 9:1 range, or constant output torque with a 6:1 range; 4. Infinitely variable over entire speed range; 5. Rapid response to speed change, precise adjustment, accurate maintenance of settings; 6. Long life and minimum maintenance; 7. Ample bearing support for overhung pulleys on either input or output shafts.

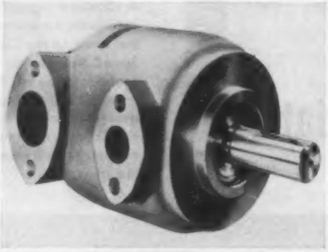
Write for Bulletin K-200 for detailed description of the Cleveland Speed Variator, with photographs, sectional drawings, rating tables and specifications.

THE CLEVELAND WORM AND GEAR COMPANY

Speed Variator Division, 3276 East 80th St., Cleveland 4, Ohio

Sales representatives in all major industrial markets. In Canada—Peacock Brothers Limited.

For more information fill in page number on Inquiry Card, on page 259



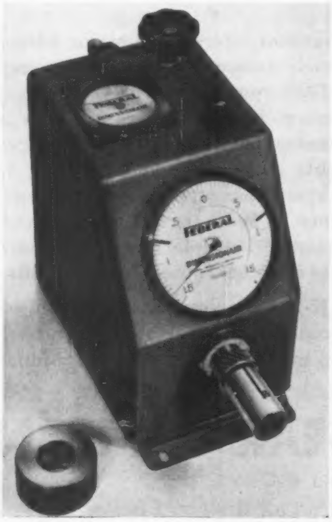
Denison High-Pressure Vane Pump

One of a new series of balanced-vane hydraulic pumps for continuous 2000-psi service announced by the Denison Engineering Division, American Brake Shoe Co., Columbus, Ohio. The pumps in this "T" series are of special construction featuring Denison's exclusive hydraulically balanced vane and are available in rated delivery capacities up to 100 gallons per minute at speeds up to 1800 rpm.

Circle Item 164 on postcard, page 259

Improved Dimensionair Air Gage

Improved model Dimensionair air gage announced by Federal Products Corporation, Providence, R. I. This gage uses the same balanced measuring system as preceding Dimensionair gages and is said to be even less sensitive to outside airline conditions and handling faults. Oil and water seepage into

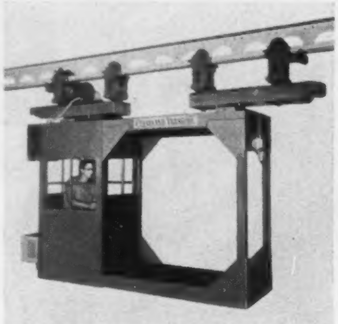


the gage from the airline has been minimized and a new, efficient filter is mounted on the gage itself. A transparent cup makes it easy to observe the contents of the filter and to judge the condition of the airline.

Circle Item 165 on postcard, page 259

Air-Conditioned Tramrail Carrier

Air-conditioned carrier for operation on overhead tramrail systems made by the Cleveland



Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. Although this carrier was designed especially for conveying ladles of hot metal used for die-casting, the platform can be changed in size and adapted for other materials-handling purposes. The carrier illustrated has a cab enclosed with aluminum paneling and is provided with air-conditioning to keep the operator comfortably cool while transporting molten metal. The door has a safety switch that prevents the carrier from being moved when the door is open. The unit has a capacity of 3100 pounds and travels at speeds up to 300 feet per minute. Carriers of other capacities and speeds can be furnished to order.

Circle Item 166 on postcard, page 259

Damascus Drawing Lead Holder for Designers and Draftsmen

A Damascus lead holder for designers, engineers, and draftsmen, which has a hardened steel clutch that grips the lead securely and re-

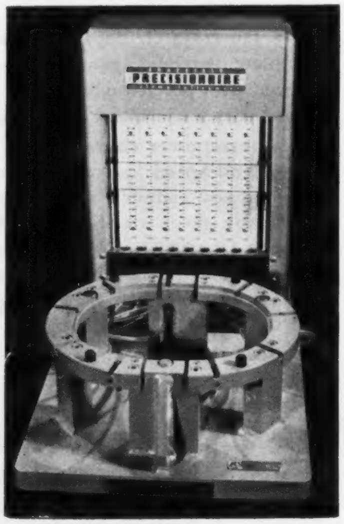
sists abrasion of sandpaper or files used in sharpening the lead, has been brought out by the Richard Best Pencil Co., Inc., Springfield, N. J. The holder is all-metal for dimensional stability and has a spring-loaded release mechanism with release buttons anodized in red, blue, or yellow colors for quick identification of the holder loaded with lead of the desired hardness for a specific drawing job. This holder is perfectly balanced and designed for a lifetime of dependable service.

Circle Item 167 on postcard, page 259

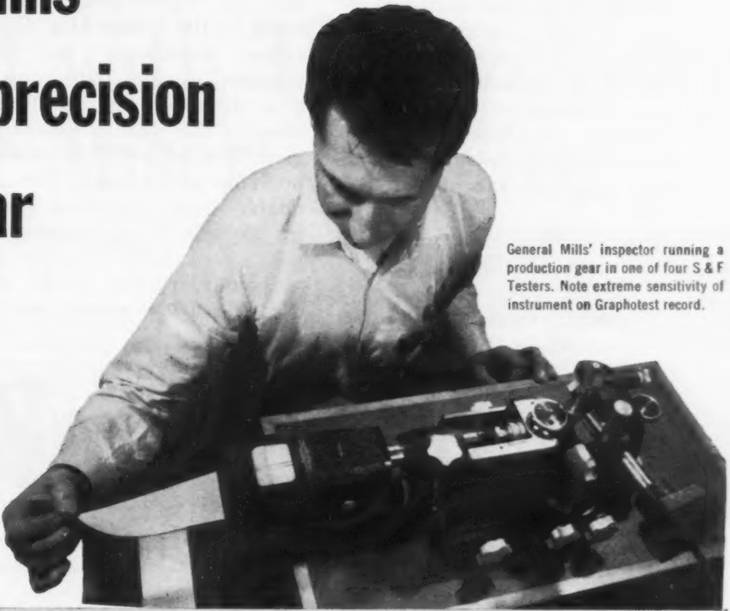
Sheffield Precisionaire Face Flatness Gage

Precisionaire pneumatic gage manufactured by the Sheffield Corporation, Dayton, Ohio, for checking flatness of a transmission bowl flange at nine places simultaneously. Four locators (black plugs) orient the part in the correct gaging position. The part is

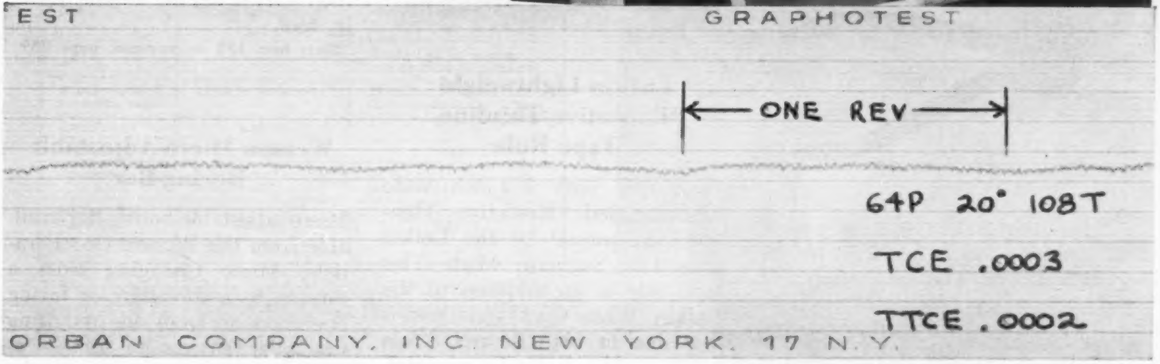
(*Continued on page 250*)



why General Mills checks every precision production gear on the S&F gear tester...



General Mills' inspector running a production gear in one of four S & F Testers. Note extreme sensitivity of instrument on Graphotest record.



because...

there's no gear tester as accurate as the S & F

Checking gears by the usual methods just isn't accurate enough to satisfy so precision-minded a producer as the Mechanical Division of General Mills. They know that their gears can be only as accurate as the instruments that test them—and only the S & F Gear Tester measures up to the highest precision standards.

Strong statement you say? Several hundred S & F Testers prove it every day in plants that took their gear accuracy seriously enough to change over to S&F—guaranteed to repeat within .00002″.

Ask us to show you why this instrument is revolutionizing gear checking. Or talk to the S & F user near you. We'll send you his name.

KO CO., INC. PRECISION MACHINERY

KURT ORBAN COMPANY, INC.

42 Exchange Place, Jersey City 2, N. J. • In Canada: 2490 Eglinton Ave. W, Toronto

For more information fill in page number on Inquiry Card, on page 259

lowered onto three rest buttons, and the flange face contacted by nine Plunjet gaging cartridges whose gage points extend slightly above the surface of the gage plate. Flatness or the amount of concavity or convexity is indicated by the relative float positions in the nine Precisionaire columns.

Circle Item 168 on postcard, page 259

Assembly Tool for Truarc Grip-Ring

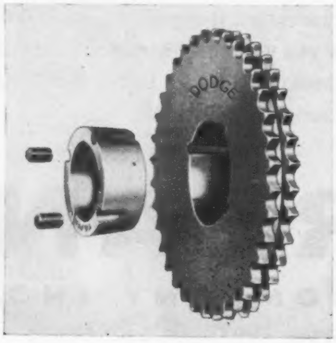
Waldes Truarc grip-ring assembly tool made by Waldes Kohinoor, Inc., New York City. This tool is designed for spreading Truarc Series 5555 grip-rings to the exact diameter required for installation. It automatically prevents over-

spreading and subsequent permanent set, and is intended for removing as well as assembling Truarc rings. The tool is available in three sizes for seating rings on shafts 5/32, 3/16 and 1/4 inch in diameter.

Circle Item 169 on postcard, page 259

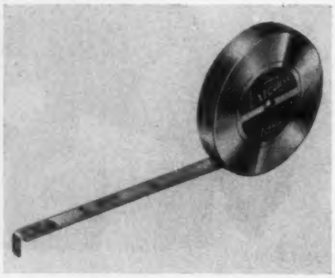
Dodge Double-Strand Taper-Lock Sprocket

Double-strand type roller chain sprocket that requires no reboring or other machining for installation



on shafts recently added to the line of Taper-Lock sprockets made by the Dodge Mfg. Corporation, Mishawaka, Ind. This sprocket provides the equivalent of a shrunk-on fit, regardless of whether the shaft is turned and ground or cold-rolled, standard or normally under-sized. The new double-strand, taper-lock sprockets are now being manufactured and are available in pitch sizes ranging from 1/2 to 1 inch.

Circle Item 170 on postcard, page 259



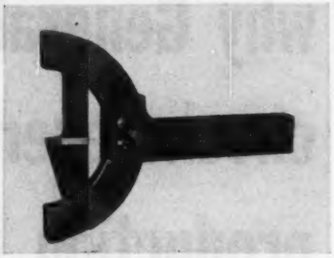
Lufkin Lightweight "Executive Thinline" Tape Rule

Tape rule with 1/4-inch wide blade, called "Executive Thinline," announced by the Lufkin Rule Co., Saginaw, Mich. This tape rule is an addition to the Lufkin "White Clad" series and is available in both 6- and 8-foot lengths. The rule is compact, about the diameter of a silver dollar, and is of extremely light weight. It has a highly polished bright chromium finish on a smoothly contoured steel case of attractive design.

Circle Item 171 on postcard, page 259

Criterion Cut-Off Tool with Carbide-Tipped Blade

Cut-off tool with carbide-tipped blade announced by the Criterion Machine Works, Costa Mesa, Calif. The blades may be purchased separately and used with all Criterion standard holders of the type illustrated. The cutting widths will remain the same as the high-speed blades previously introduced. The 0.060-inch wide sizes will part stock 1 1/2 inches in diameter and the 0.090-inch



wide size handles stock up to 3 and 4 inches in diameter. A heavy-duty model for parting or grooving 4-inch diameter stock of materials containing properties that make machining difficult and a larger tool capable of parting stock up to 6 inches in diameter are also available. Blades for these latter tools are available in both high-speed and carbide in cutting widths of 0.090 inch for the 4-inch capacity, and 0.125-inch widths for the 6-inch capacity tool.

Circle Item 172 on postcard, page 259

Wesson Micro-Adjustable Boring-Bar

Micro-adjustable boring-bar available from the Wesson Co., Ferndale, Mich. Changing from a turning to a threading or facing operation or, from one requiring triangular inserts to round or square throw-away inserts, can be accomplished with these micro-adjustable boring-bars. The complete tool change-over requires only the interchanging of one piece—the standard anvil. The rest of the boring-bar (including chip-breaker clamp and micro-adjustment) requires no changing.

Circle Item 173 on postcard, page 259

Machining Titanium at Lower Cost with Throw-Away Carbide Insert Tooling

V-R Face Mill Cutters Save $169.60 In Machining 1186 Cu. In.

A change from brazed tipped tools to throw-away insert carbide tooling has effected major economies in machining titanium at Convair Division of General Dynamics Corporation (San Diego Plant II). Following is a typical example.

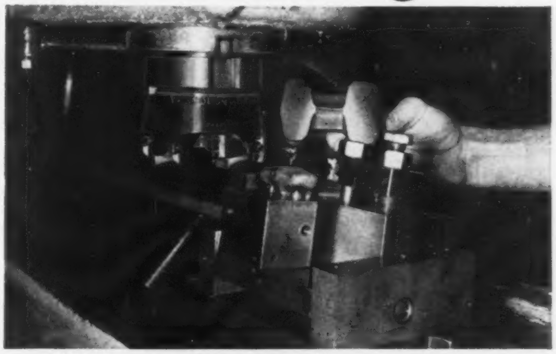
Job: Machining AMS 4925 titanium bar stock on Cincinnati vertical mill. Depth of cut from .08" to .220". Feed .004 IPT. Speed 95 RPM (100 SFM). Total stock removal 1186 cubic inches. V-R grade 2A5 carbide throw-away inserts.

COST COMPARISON

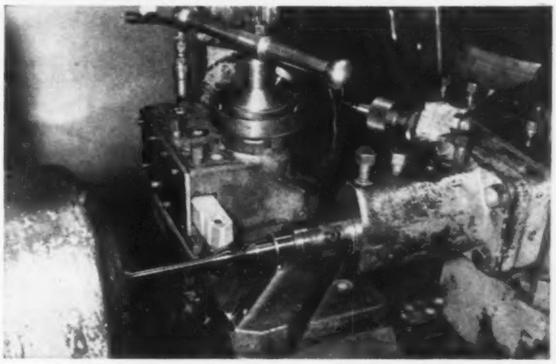
	Old Method	New Method
Tool	Brazed tip cutter	Vascoloy-Ramet 4" dia., 30° lead angle neutral rake cutter with V-R Grade 2A5 ⅜" square carbide throw-away inserts
Stock removal per cutting edge	25 cu. in. per grind	99 cu. in. per corner (4 usable corners)
Carbide cost	$20.00	$33.60
Regrind cost	$94.00	None
Downtime	470 minutes for cutter changes—$94.00	24 minutes for insert changes—$4.80
TOTAL COST Tool repair and downtime	$208.00	$38.40

For complete data on cost-saving V-R throw-away insert style face mill cutters, ask for Bulletin VR-571; for single point toolholder data, Catalog VR-437. Call your local V-R Representative or Distributor, or write:

FM-600



V-R throw-away insert face mill cutter machining titanium at Convair Division.



V-R toolholder and carbide insert turning titanium at Convair Division.

Convair-built F-102A supersonic jet interceptor incorporates many titanium parts.

Display of typical Vascoloy-Ramet throw-away insert type tools used at Convair Division.

Cemented Carbides • Tantung Cast Alloys
Toolholders • Carbide Cutting Tools

858 S. Market Street
Waukegan, Illinois

Vascoloy-Ramet Corporation

SUBSIDIARY OF FANSTEEL METALLURGICAL CORPORATION

For more information fill in page number on Inquiry Card, on page 259

By E. S. Salichs

BETWEEN GRINDS

Did You Flash, Sir?

Medical researchers have devised a "radio pill," a plastic capsule that sends out FM signals as it passes through the human body. It is the world's smallest FM radio broadcast station, according to *Industrial Research Newsletter* (published by Armour Research Foundation of Illinois Institute of Technology).

Bonanza at Bat Cave

In the depths of the Grand Canyon is a prehistoric treasure of guano, valuable as a fertilizer and source for drugs, now made accessible by engineers of the United States Steel Corporation. An aerial freight tramway was devised, one of the most difficult phases of the operation being the stringing by helicopter of 11,500 feet of 1/8-inch construction cable across the 2911-foot gorge in which Bat Cave is located. The cave, its entrance situated about 600 feet up the precipitous canyon wall above the Colorado River, was discovered in the 1930's, but only recently was this economic method of removing the deposit developed. The guano will be picked up by a giant vacuum cleaner; the deposit is estimated as worth at least $10,000,000. We wouldn't mind emptying our vacuum cleaner bag on those terms.

Explosive Wall—and Words

Firemen summoned to a house by an excited housewife who claimed her kitchen wall was roaring discovered, and without using their axes, the source of the noise. A dining-room chair was resting on the floor service button designed to ring a buzzer in the kitchen.

Flier of Wire

A bird in Fort Wayne, Ind., has designed a durable nest for himself and family. He gathered tiny strands of stainless-steel wire at Fort Wayne Metals, Inc., which makes unusually fine filters. Allegheny Ludlum Steel Corporation supplies the stainless to them, as well as to the bird, it seems.

Coupon-Come-Lately

The Landis Tool Co. recently received a coupon cut from an advertisement that had appeared in September, 1951, MACHINERY (how we stay around), offering a copy of a Landis pamphlet, *Better Grinding*. The clipping came from a New Yorker to whom it had been sent by a friend in Israel.

Uncle Sam's Great Anti

As of the moment, we read in the newspaper, there is no defense against the Intercontinental Ballistic Missile, although the Army is doing research on the possibility of an anti-missile missile. Are we stuttering? No, just staggering. The I.C.B.M., when operational, will be able to carry a hydrogen warhead a distance of 5000 miles through the stratosphere in about thirty minutes.

WHISTLING ON THE WIRE?—No, the attractive young lady is blowing gently on a test specimen of wire, while the appreciative young man is registering her breath in the series of dots on the glass behind her, to demonstrate a Dilatometer at Northrop Aircraft, Inc., Hawthorne, Calif. The machine, combining photographic equipment and an electronic furnace capable of heating specimens to 2000 degrees F., is one of the few in this country. It determines even the most infinite coefficients of expansion of metals under heat, useful in probing thermal barriers.

FRACTIONAL HORSEPOWER GEARING

GS

GEAR
Specialties, Inc.
2635 WEST MEDILL AVENUE
CHICAGO 47, ILLINOIS

SPURS • SPIRALS • HELICALS • BEVELS • INTERNALS
WORM GEARING • RACKS • THREAD GRINDING

WORLD'S LARGEST EXCLUSIVE MANUFACTURERS
OF FRACTIONAL HORSEPOWER GEARING

Top precision in the G. S. 5 and 8 thread hardened and ground Worms pictured above, is consistently maintained on G. S. precision equipment. Accuracy and uniformity of lead, and thread spacing accuracy, of vital importance in precision multiple Worms, is under the strict control of highly skilled workmen. The 4 thread Worm has hobbed threads, case hardened and polished. This method is more economical and a great degree of accuracy is maintained through G. S. specialized heat treating. The 3 thread Worm is hobbed and brushed. This most economical method is recommended for *unhardened* multiple thread Worms. The single thread Worm is precision ground from the solid, on a heat treated shaft. ★ G. S. men, methods and machines are developed to produce a degree of accuracy, efficiency and economy that will cut costs and improve product performance for you. Modern equipment and extensive inspection facilities assure absolute control of quality. Customer furnished blanks or a complete job, optional. Send drawings or details, today.

41 Years of Specializing in Small Gearing!

For more information fill in page number on Inquiry Card, on page 259

News OF THE INDUSTRY

California

Contracts have been signed for the sale of HUFFORD MACHINE WORKS, INC., El Segundo, Calif., to the PACIFIC INDUSTRIES, INC., with headquarters in San Jose, Calif. Merrill L. Bengston will continue as president of Hufford but has now also been named a director of Pacific Industries and chairman of the executive committee. No changes in Hufford personnel or management are contemplated.

CHARLES N. PERRY, purchasing agent for Rockwell Mfg. Co.'s Oakland, Calif., plant for the past five years, has been named factory manager of the company's new Porterville, Calif., plant.

(Left) H. Daniel Robb, national product manager, alloy steels; and Clive C. Earle, sales manager of the Buffalo plant of Joseph T. Ryerson & Son, Inc.

Georgia, Florida and Tennessee

SOUTHERN TOOL DISTRIBUTING Co., Atlanta, Ga., has been appointed sales representative for the Taft-Peirce Mfg. Co., Woonsocket, R. I., and will handle Taft-Peirce instruments, gages, fixed gages, magnetic chucks, and toolroom equipment throughout Georgia and northern Florida.

HARRY P. LEU, INC., 100 W. Livingston Ave., Orlando, Fla., has been appointed sales representative for the Taft-Peirce Mfg. Co., Woonsocket, R. I. and will cover the entire state of Florida outside the northwestern area.

NOLAND CO., INC., Chattanooga, Tenn., has been appointed distributor for Niagara Machine & Tool Works, Buffalo, N. Y., in Georgia and Tennessee. The company will distribute Niagara's entire line of presses, press brakes, shears, and related machines and tools.

Illinois

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., announces the following appointments: H. DANIEL ROBB has been promoted to national product manager, alloy steels, with headquarters in the company's general offices in Chicago. CLIVE C. EARLE has been appointed sales manager for the company's Buffalo plant. JAMES E. BURKE has been appointed manager of alloy and stainless steel sales in the Pittsburgh Steel Service plant. WILLIAM J. WALLER has become manager of the work order department, while RICHARD T. ROLLISON has taken over the post of manager of the reinforcing steel products department, at Wallingford, Conn. MILTON C. FIDGEON was named assistant sales manager of the New York area steel service plant located in Jersey City, N. J. HARRY A. ZAHN has been appointed manager of alloy steel sales at the Philadelphia steel service plant.

CHICAGO-LATROBE TWIST DRILL WORKS, Chicago, Ill., announces the following sales appointments: HERBERT A. DARTSCH has been named sales representative for the Chicago territory; JAMES F. MARSHALL will cover Detroit, Mich., area as salesman; and EVERETT E. SLITOR will represent the company in the southern Ohio territory.

ANDREW L. PONTIUS has been elected a vice-president of the Illinois Tool Works, Chicago, Ill. Mr. Pontius joined the company in 1952 and was made general manager of the company's Shakeproof Division in 1955.

E. C. WESTPHAL has been named an assistant sales manager at Rolled Steel Corporation, Skokie, Ill. He has been with the company since 1953.

E. C. WILSON has been elected vice-president of the Illinois Gear & Machine Co., Chicago, Ill. Mr. Wilson has been associated with the company since 1942.

E. C. Wilson, vice-president, Illinois Gear & Machine Co.

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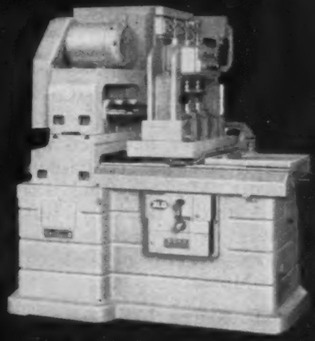
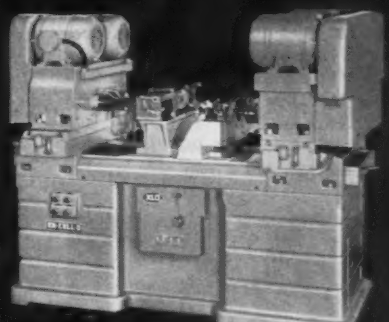


STYLE 112-D. Large and sturdy with long stroke. Accommodates medium and heavy work, gives maximum precision production, minimum operating cost.



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Bruce E. Horst, sales manager, Machine Tool Division, Barber-Colman Co.

(Left) F. V. Gieryn, sales manager, industrial department; and Russell Dupuis, manufacturing manager, Machinery Hydraulics Division, Vickers Incorporated

BRUCE E. HORST has been appointed sales manager of Barber-Colman Co.'s Machine Tool Division, Rockford, Ill. He was formerly sales representative in the Rockford area and is being replaced by WESLEY MORSE.

JOSEPH R. SMITH has been appointed western district manager for Flick-Reedy Corporation, Melrose Park, Ill. Mr. Smith will be responsible for sales in all states west of the Mississippi River for the firm's two divisions.

O. E. MARTHINSON has been elected vice-president in charge of Eastern sales for Graymills Corporation, Chicago, Ill. Mr. Marthinson, who opened the first Eastern sales office for Graymills, has been with the company since 1941 and will maintain headquarters for sales operations in Allentown.

F. A. De Christopher Studios

O. E. Marthinson, vice-president of Eastern sales for the Graymills Corporation

Michigan

VICKERS INCORPORATED, Detroit, Mich., announces the following appointments: F. V. GIERYN was named sales manager, industrial department; and RUSSELL DUPUIS has been made manufacturing manager, Machinery Hydraulics Division. Mr. Gieryn was formerly manager of export sales. In his new capacity, he will supervise sales of the company's hydraulic units and systems for machine tools and other plant production machinery through twenty industrial sales offices located throughout the United States. Mr. Dupuis will manage machinery hydraulics production in the Machinery Hydraulic's Division's plants at Omaha, Neb.; Waterbury, Conn.; and El Segundo, Calif. At the same time it was announced that ROBERT A. ERSKINE has been appointed chief engineer, industrial department, Detroit, Mich.

ROBERT N. KENDALL has been appointed vice-president of Colonial Broach & Machine Co., Detroit, Mich. Mr. Kendall, who has served as sales research consultant with headquarters in Washington, D. C., was for many years sales engineer for Colonial in the Detroit area. He will continue to make his headquarters in Washington.

TURCHAN FOLLOWER MACHINE Co., formerly of Detroit, has moved into new buildings at 26950 Van Born Road, Inkster, Mich. The new plant provides 20,000 square feet of floor space to accommodate greatly increased engineering, experimental, and manufacturing facilities.

RIORDAN MACHINERY Co., Detroit, Mich., has been appointed representative for the Chambersburg Engineering Co., Chambersburg, Pa., in the eastern Michigan, Toledo, and Fort Wayne areas.

W. A. JOHNSON has been appointed sales manager of the Grinder Division, Royal Oak Tool & Machine Co., Royal Oak, Mich.

New England

WILLIAM H. MCMANUS, hoist sales executive for Yale Materials Handling Division, Yale & Towne Mfg. Co., has been appointed New England hoist district sales manager. Mr. McManus, who will make his headquarters in Boston, replaces ROGER R. REYNOLDS who has been transferred to the Texas, Oklahoma, and Louisiana sales territory.

L. S. STARRETT Co., Athol, Mass., announces the appointment of four salesmen in the following areas: RICHARD H. CHACE, San Francisco, Calif., CHARLES B. WHIPPS, Toronto, Ontario, Canada; ALLAN B. CARRUTH, Atlanta, Ga.; and ROBERT J. CARNEY, Los Angeles, Calif.

CHARLES W. MOORE has been appointed representative for the S. W. Card Division of Union Twist Drill Co., Athol, Mass., for West Virginia, western Ohio, and a part of Kentucky.

BRYAN W. MOYLAN has been appointed sales engineering representative for the Hydraulics Products Division of Brown & Sharpe Mfg. Co., Providence, R. I. He will be responsible for the development of markets for the company's hydraulic products along the Eastern seaboard of the United States.

(*This section continued on page 266*)

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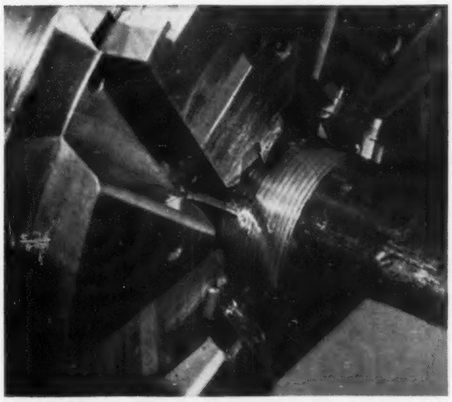

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On New Shop Equipment described in the editorial pages
On products shown in the advertisements

NEW CATALOGUES

CORROSION-RESISTANT ALLOYS — Haynes Stellite Co., Division of Union Carbide Corporation, New York City. 104-page booklet entitled "Hastalloy Corrosion-Resistant Alloys," giving up-to-date information on four nickel-base alloys—Hastalloy alloys B, C, D, and F. Described are chemical compositions, physical, mechanical, and high-temperature properties. Also included is a table of the comparative resistances of these alloys to over 250 corrosives commonly handled in the chemical, petroleum, paper and pulp, pharmaceutical, and metalworking industries. A separate section describes techniques for forging, cold-working, machining, grinding, and welding. Copies can be obtained from the Advertising Department, Haynes Stellite Co., Division of Union Carbide Corporation, 420 Lexington Ave., New York 17, N. Y.

ABRASION-RESISTING STEEL—Joseph T. Ryerson & Son, Inc., Chicago, Ill. Revised bulletin describing a specially balanced composition for hardness and ductility, supplied in sheet and plate form for structures and equipment subjected to abrasion. This product is said to give from two to ten times longer service than ordinary low-carbon steel, exceed some of the higher carbon steels in wear resistance, and compare favorably in service with more costly rolled and cast alloys. Included is information on fabrication and heat-treatment. 1

CARBIDE FACE MILLS—Niagara Cutter Division, Bollier-Damerell, Inc., North Tonawanda, N. Y. Illustrated folder describing the company's line of shank type carbide face mills especially designed to increase output of aluminum, brass, and steel parts on popular size Bridgeport type vertical milling machines. These carbide face mills are offered in fourteen standard models with 1 1/2-, 2-, and 2 1/2-inch diameter cutters with integral 3/4-inch straight shanks and over-all length of 2 7/8 inches. 2

SHEAR KNIFE HANDBOOK—American Shear Knife Co., Homestead, Pa. Ring-bound handbook giving in detail the grades of shear knives available, information for selecting the correct grade of knife, recommended applications, proper tolerances, and knife-setting suggestions. The same information is given for rotary slitter knives and spacers. Information is also given on the care of shear knives and slitter knives, such as regrinding, storage, and setting. 3

SINGLE-PHASE INDUCTION MOTORS—General Electric Co., Schenectady, N. Y. Bulletin GEC-1419, describing the company's Tri-Clad, 55, single-phase induction motors from 3/4 to 5 hp; frames 182, 184, 213, 215; 115 to 230 volts; 60 cycles. Application data, types, ratings, frame sizes, and construction features of drip-proof and enclosed single-phase induction motors are given. 4

VERTICAL TURRET LATHES—Kaukauna Machine & Foundry Division of Giddings & Lewis Machine Tool Co., Kaukauna, Wis. 24-page catalogue describing the company's line of 32-, 42-, and 52-inch vertical turret lathes. Presenting entirely new concepts, operating speeds, simplicity, and convenience, these machines provide an individual station, complete with all applicable controls, for each separate head. 5

METAL-SHEARING AIDS—Hill Acme Co., Cleveland, Ohio. Ring-bound folder covering various types, sizes, and grades of Cleveland metal-cutting knives best suited to all types of metal shearing. Slitters, squaring blades, alligator, and bar knives are included. Care and handling, best cutting practice, and recommended grades for various operations are included, together with specifications. . . 6

WELDING BLOWPIPES—Linde Company, Division of Union Carbide Corporation, New York City. Illustrated folder describing three Oxweld welding blowpipes. Operation on low-pressure acetylene is the unique feature of the three blowpipes described. Low-pressure operation makes it possible to work these blowpipes at acetylene pressures less than 1 psi, which is far below pressure requirements of ordinary blowpipes. . . . 7

HYDRAULIC POWER UNITS—Oil-Dyne, Inc., Chicago, Ill. 52-page catalogue describing hydraulic power units including pumps, cylinders, pressure switches, and accessories. Complete technical data and specifications are given on 2240 different types and models; single- and duplex-pressure switches; hydraulic cylinders; and a full line of accessories, including tube connectors, valves, hydraulic hose and fittings, and tubing and gages. 8

STAINLESS-STEEL SHEET AND STRIP—Allegheny Ludlum Steel Co., Pittsburgh, Pa. 32-page booklet containing information on stainless-steel sheet and strip.

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Included are more than twenty tables giving detailed data on a stainless-steel finder, corrosion resistance of various stainless steels, fabrication properties, and weight tables per lineal foot in various widths and gages. **9**

NUMERICAL POSITIONING CONTROL —General Electric Co., Specialty Control Department, Waynesboro, Va. Bulletin GET-2675, describing the functions of numerical positioning control and giving a detailed breakdown of the three major elements—data input, director, and servo drive. Features are illustrated, and each operation is graphically shown. **10**

SCREW-LOCK INSERTS—Heli-Coil Corporation, Danbury, Conn. Bulletin 738, describing the company's complete line of screw-lock inserts, including the new miniature size 4-40 insert. The bulletin also contains selection tables with thread sizes, insert numbers and sizes, and complete information on controlling, tapping, gaging, and installation. **11**

JIGS AND FIXTURES—Harco Engineering, Detroit, Mich. Catalogue describing the company's jigs and fixtures. Full-scale templates of all Harco products are assembled in loose-leaf form to simplify removal for detailing and tracing. Products included are: fixture clamps, fixture keys, cams, screws, nuts, washers, hand knobs, and handwheels. **12**

GRINDING-WHEEL DRESSER—Threadwell Tap & Die Co., Greenfield, Mass. 4-page folder describing the company's Tangi-Matic dresser. Detailed explanation of operation is given, along with specifications and special features of the machine that will do precision dressing of grinding wheels to any desired form faster than by conventional methods. . . . **13**

CONTROLLED-VOLUME PUMPS—Milton Roy Co., Philadelphia, Pa. Bulletin 553-1, describing the company's complete line of motor-driven, controlled-volume pumps. Complete specifications and latest design data on these positive displacement pumps are included. Standard and modified models and their applications are illustrated and described. **14**

RESISTANCE WELDERS — Taylor-Winfield Corporation, Warren, Ohio. Bulletin 8-313, describing the company's resistance welder designed to mass-produce electrical contact, conductor, and terminal assemblies. Illustrated are samples of welded assemblies, special welding equipment, and tooling required for mechanized handling. **15**

BROACHING TOOLS—LaPointe Machine Tool Co., Hudson, Mass. 24-page booklet entitled "How to Care for Broaching Tools," giving hints on the handling of broaching tools while in use on the machines, when being resharpened, and during transfer in the shop from one department to another. Close-up photographs and cartoons illustrate the various points. **16**

CONTROL VALVES—C. B. Hunt & Son, Inc., Salem, Ohio. 12-page bulletin describing the company's "Quick-As-Wink" air and hydraulic control valves, including sliding sleeves, single plunger, "O" type, "B" type, and high-pressure hydraulic valves. The construction and operation of each valve, and the service for which each is best suited, are described in detail. **17**

MOTORS AND DRIVES—Reliance Electric & Engineering Co., Cleveland, Ohio. 8-page booklet entitled "The Moving Force of Industry," describing the company's complete line of alternating- and direct-current motors, gear-motors, motor-generator sets, motor controls, and completely packaged mechanical and electronic adjustable-speed drives. **18**

DIAGONAL GEAR-SHAVING MACHINE —National Broach & Machine Co., Detroit, Mich. 4-page illustrated catalogue describing the company's Red Ring universal, diagonal, gear-shaving process. The basic design features of the Model GCU Red Ring diagonal shaving machine, which is built in three types, are described and illustrated in detail. **19**

HEAVY-DUTY POWER SAW—DoALL Co., Des Plaines, Ill. Catalogue describing the company's vertical feed, Model 24 power saw. This 24-by-24-inch capacity machine sets new performance standards of cut-off sawing on large billets, bars, tubing, and heavy structural beams. Specifications and design features are illustrated and described. **20**

COLD-ROLLED SPRING STEELS—Sandvik Steel, Inc., Fair Lawn, N. J. Illustrated bulletin describing the company's spring and specialty strip steels, including specification information on some of the leading types of strip steels. Each type is illustrated by application, and the material, finish, usual size range, and chemical analysis in per cent is given for each. **21**

ALLOY LINERS—Pangborn Corporation, Hagerstown, Md. Bulletin 332-B, describing the company's Wear-Resist liners for better protection of blast cleaner parts subject to abrasive action. Included also is application information and specification data for both Rotoblast wheels and the Pangborn Blastmaster. **22**

POSITIVE-INDEX TABLE — Colonial Broach & Machine Co., Detroit, Mich. Bulletin JF-57, describing the design, operation, and application of the company's positive-index table. The universal table uses a no-backlash gear mechanism to provide high-precision indexing control. **23**

GEAR-DRIVEN POSITIONERS—Aronson Machine Co., Arcade, N. Y. Bulletin HD 57, describing the company's gear-driven positioners and containing complete specifications. There are eight different models of these positioners ranging from 500- to 24,000-pound capacity. **24**

OSCILLOGRAPHS—Brush Electronics Co., Cleveland, Ohio. 8-page folder illustrating and describing five models of the company's multi-channel rack mounting oscillographs. These instruments permit simultaneous recording up to eight phenomena in clearly legible chart form. **25**

PRECISION TOOLS AND GAGES—Brown & Sharpe Mfg. Co., Providence, R. I. Catalog 36M, covering the company's entire line of precision tool and gage equipment, including several hundred new items. All specifications and prices are included. **26**

Product Information Service

Use postage-free Business Reply Card below for further information on New Catalogues or New Shop Equipment described in this issue and products mentioned in the advertisements.

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ELECTROLIZING PROCESS—Electrolizing Corporation, Chicago Heights, Ill. 24-page catalogue outlining how electrolizing overcomes friction, wear, abrasion, galling, and fretting corrosion problems, and at the same time increases mechanical reliability. **27**

LUBRICANTS—Alpha Molykote Corporation, Stamford, Conn. 16-page bulletin entitled "Breaking Lubrication Barriers," giving details on the development of the company's line of molybdenum disulfide lubricants. Covered are the physical and mechanical properties of the compound. **28**

WIRE ROPE—Hazard Wire Rope Division, American Chain & Cable Co., Inc., Wilkes-Barre, Pa. Bulletin entitled "Wire Rope Recommendations for General Contractors," describing the company's complete line of lay set preformed wire rope, wire rope accessories, and Dualoc boom cable assemblies. **29**

FORGED-STEEL COUPLETS—W-S Fittings Division, H. K. Porter Co., Inc., Roselle, N. J. 4-page bulletin describing the company's complete line of couplets. Dimensional specification data on the screw-end and socket-welding couplets and on the 90-degree elbow couplet are included. **30**

POWER TRANSMISSION EQUIPMENT—Clark Equipment Co's Transmission Division, Jackson, Mich. 12-page booklet describing the company's synchronous transmission series, StepMatic transmissions, TransVerters, and torque converters ranging from 11 to 26 inches in size. . . . **31**

SPRAY BOOTHS—DeVilbiss Co., Toledo, Ohio. Catalogue 1-7000, describing spray booths of every type, size, and application, including custom-designed units and ready-made units that can be erected with a wrench and screwdriver. **32**

SPLINE-HOBBING MACHINE — Lees-Bradner Co., Cleveland, Ohio. Illustrated catalogue describing the company's spline-hobbing machine that hobs up to 144 inches between centers. **33**

ROTARY FILES—Heller Tool Co., Subsidiary of Simonds Saw & Steel Co., Newcomerstown, Ohio. Illustrated catalogue R-48, describing the company's various rotary files. **34**

FLEXIBLE ACTUATOR SWITCH—Micro Switch, a Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill. Data sheet 113, describing and illustrating the company's flexible actuator switch. . . **35**

COUPLING—Snap-Tite, Inc., Union City, Pa. Bulletin 270, describing the company's quick-connect, quick-disconnect HK coupling, which will handle acids, alkalies, solvents, and high-pressure steam. **36**

STAMPING PRESSES—Alpha Press & Machine, Inc., Detroit, Mich. Catalogue 57-2, describing the company's two-point, back-gear underdrive, high-speed, automatic, production stamping presses. . . **37**

TORQUE TESTING FIXTURES—P. A. Sturtevant Co., Addison, Ill. Illustrated folder describing the company's torque testing fixtures. Typical applications are illustrated, and brief explanations are given. **38**

PROFILER—Arrow Engineering Co., Inc., Indianapolis, Ind. Bulletin PR-156, describing high-speed contouring, pocketing, and swarf cutting of aluminum, titanium, and steel with the company's profiler. **39**

RIGHT-ANGLE GEAR-MOTORS — Sterling Electric Motors, Inc., Los Angeles, Calif. Illustrated folder describing the company's foot- and shaft-mounted right-angle gear-motors. **40**

ROUTER BITS—Detroit Tap & Tool Co., Baseline, Mich. Bulletin RB-56, describing the company's chrome-cobalt, high-speed steel router bits for non-ferrous metals, plastics, and wood. **41**

HIGH-SPEED END-MILLS — Chicago-Latrobe, Chicago, Ill. 16-page catalogue giving information on the company's entire line of high-speed end-mills. Complete dimensions and technical data are included. **42**

CUTTING TOOLS—Sintox Corporation of America, Allentown, Pa. Illustrated folder describing the company's cutting tools for all materials. Specifications and prices are included. **43**

HONING TOOLS — Barnes Drill Co., Rockford, Ill. Bulletin 570, describing the company's BarnesdriL honing tool designed for individual job and shop requirements. **44**

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PACKAGED FITTINGS — W-S Fittings Division, H. K. Porter Co., Inc., Roselle, N. J. 4-page bulletin presenting complete data on a new packaging concept for W-S forged steel pipe fittings. Included are the quantities of each type and size of each fitting packaged in the various sizes of cartons, the dimensions of each carton, and the weights of the packaged quantities of each fitting. **45**

SINGLE - SPINDLE AUTOMATICS — Cleveland Automatic Machine Co., Cincinnati, Ohio. Bulletin describing the company's Model B automatic which comes in 1 5/8 and 2 1/2 inches. These machines are well suited for producing such parts as shafts, arbors, spindles, studs, pins, and axles. **46**

BRASS VALVES—Crane Co., Chicago, Ill. Folder describing the company's brass, composition-disc globe, angle, and lift check valves. Advantages of this brass valve for a broad range of services, including steam, water, air, oil, gas, and gasoline are outlined. **47**

TOOLS AND DIES—Jaquith Carbide Division of Pratt & Whitney Co., Lynn, Mass. Illustrated catalogue describing the company's carbide tools and dies. . . . **48**

SURFACE GRINDER—Covel Mfg. Co., Benton Harbor, Mich. Bulletin 177, describing the company's No. 17, 10- by 16-inch hand-feed surface grinder. . . **49**

BARREL FINISHING—Minnesota Mining & Mfg. Co., St. Paul, Minn. 12-page catalogue describing the company's barrel-finishing process. **50**

BELLOWS — Belfab Corporation, Agawam, Mass. Illustrated catalogue covering the company's welded bellows in stainless steel and similar alloys. . . . **51**

EXCHANGERS — Whitlock Mfg. Co., West Hartford, Conn. Bulletin 14, describing the company's Hi-Transfer exchangers. **52**

DUST CONTROL—Pangborn Corporation, Hagerstown, Md. Bulletin No. 922, describing and illustrating the company's dust controls for industry. **53**

SHELL MOLDING—Dow Corning Corporation, Midland, Mich. Folder describing the shell-molding process with the company's silicone parting agents. . . **54**

CENTERLESS GRINDER—Royal Master, Inc., Riverdale, N. J. Illustrated folder describing the company's TG-12 centerless grinder. **55**

HYDRAULIC PRESS BRAKE—Superior Machine Co., Memphis, Tenn. 4-page bulletin describing the company's hydraulic press brake. **56**

CONTINUOUS FURNACES — Hevi-Duty Electric Co., Milwaukee, Wis. Bulletin 357, describing the company's conveyor and pusher furnaces. **57**

SPECIAL ASSEMBLY MACHINES—Omer E. Robbins Co., Detroit, Mich. Illustrated folder describing the company's Assemblimatic special assembly machines. **58**

TUBE CUT-OFF MACHINE—Grieder Industries, Inc., Bowling Green, Ohio. Illustrated folder describing the company's tube cut-off machine. **59**

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DoALL Sets New Industry Standards for Gage Blocks...and Reduces Prices

COMPARISON OF DoALL GAGE BLOCK STANDARDS
WITH NATIONAL BUREAU OF STANDARDS CRITERIA AS OF FEB. 1, 1957.

GRADE		LENGTH		FLATNESS		PARALLELISM		SURFACE FINISH		HARDNESS		GENERAL COMMENTS
DoALL	BUREAU	DoALL	BUREAU	DoALL	BUREAU	DoALL	BUREAU	DoALL	BUREAU	DoALL	BUREAU	
AAA	None	+.000001″ −.000001″	None	.000001″	None	.000001″	None	0 to 0.09 AA	None	66 Rc	None	Finest blocks manufactured commercially
AA	AA	+.000002″ −.000002″	+.000002″ −.000002″	.000002″	.000002″	.000002″	.000002″	0 to 0.09 AA	0.5 AA	66 Rc	65 Rc	Most accurately calibrated AA Blocks available
A+	None	+.000004″ −.000002″	None	.000004″	None	.000004″	None	0 to 0.09 AA	None	66 Rc	None	A+ Grade for the price of B
A	A	+.000006″ −.000002″	+.000006″ −.000002″	.000004″	.000004″	.000004″	.000004″	.8 AA	.8 AA	65 Rc	65 Rc	New low priced "working" SHOP-BLOCKS
None	B	None	+.000010″ −.000006″	None	.000006″	None	.000006″	None	1.2 AA	None	65 Rc	Not recommended for today's tolerances

Every DoALL Gage Block is unconditionally guaranteed to meet DoALL specifications for its grade as shown above.

Here is What Has Been Done:

- **B Grade blocks discontinued** *on the basis of their inadequacy for controlling modern tolerances.*
- **New AAA Grade (± .000001″) established** *for ultra-precision control.*
- **AA Grade (± .000002″) reduced in price** *as much as 70%, permitting wide usage for routine inspection work.*
- **New A+ Grade (+ .000004″, 000002″) established** *for inspection and shop use, and offered at B grade prices.*
- **New optical surface finish of 0 to 0.09** *arithmetical average for AAA, AA and A+ blocks, permitting more accurate calibration and lengthening block life.*
- **New A Grade "working" SHOP-BLOCKS** *established and offered at B grade "working" block prices!*

Better Blocks for Better Control

Completely new gage block standards have been established by The DoALL Company after a comprehensive appraisal of modern measurement needs.

With .001″ a common tolerance today, B grade blocks no longer provide adequate dimensional control of working gages in the *shop*. And when parts tolerances of 100, 75, 50 and 25 millionths are specified, the need for blocks of greater accuracy becomes apparent immediately.

To meet these conditions . . . to reduce costs, rejects and waste . . . DoALL has upgraded its entire gage block line as shown at the left and in the table above. At the same time new manufacturing techniques and increased production have made possible major price reductions. For example, you get *A+ grade blocks for the price of B.*

Note that B grade blocks have been completely discontinued. Even the new DoALL SHOP-BLOCKS are A grade . . . available at the price of B "working" blocks.

DoAll now offers you the most accurate line of gage blocks in the world. They provide finer, lower cost dimensional quality control than has ever before been available. Why not take advantage of it . . . at no premium in price. Call DoALL locally or write today.

ASK FOR LITERATURE

DoALL

THE DoALL COMPANY
Des Plaines, Illinois

For more information fill in page number on Inquiry Card, on page 259

JOHN H. WRIGHT has been appointed field engineer for the Nelco Tool Co., Manchester, Conn. In his new position, Mr. Wright will perform sales liaison between the carbide tool user, the distributor, and Nelco plants in Manchester and Berlin, Conn.

JAMES W. CASWELL has been appointed Southeastern representative for the Socket Screw Division of Bristol Co., Waterbury, Conn. Mr. Caswell will make his headquarters at 216 Healey Bldg., Atlanta, Ga.

R. W. SELVIG has been appointed sales representative for the New York and New Jersey territories for Helicoid Gage Division, American Chain & Cable Co., Inc., Bridgeport, Conn.

CHAGNON Co., 70 Mack St., Windsor, Conn., has been appointed representative in the Connecticut and New England areas for the Instrument Division of Engis Equipment Co., Chicago, Ill.

New York and New Jersey

ACF INDUSTRIES, INC., New York City, has combined its Nuclear Energy Products and Erco Divisions. Headquarters of Nuclear Products-Erco will be at the Erco plant in Riverdale, Md., near Washington, D. C. Erco—formerly Engineering & Research Corporation—was acquired by ACF in 1954.

OSCAR B. SCHIER, II, has been designated secretary-elect of the American Society of Mechanical Engineers, New York City. He will succeed CLARENCE E. DAVIES, who will retire as secretary after twenty-three years of service.

FRED L. PLUMMER has been appointed national secretary of the American Welding Society. He will assume his new duties immediately and will maintain his office at the Society's national headquarters in New York City.

MASERATI CORPORATION OF AMERICA has moved to new and larger quarters at 46 Sea Cliff Ave., Glen Cove, Long Island, N. Y.

W. GERALD LANTERMAN has been named manager of sales, Industrial Division, Lamson Corporation, Syracuse, N. Y.

PANGBORN CORPORATION, Hagerstown, Md., announces that its New York City office has moved to 4 Franklin Bldg., 1025 Broad St., Newark, N. J.

Ohio

SHEFFIELD CORPORATION, Dayton, Ohio, a subsidiary of Bendix Aviation Corporation, announces the following appointments: O. A. AHLERS, senior vice-president, has been given the over-all direction of the Machine Tool, Contract Manufacturing, and Threadwell-Conway Tap & Die Product Divisions. W. FAY ALLER, previously vice-president of the Autometrology Division, is appointed vice-president to supervise and coordinate the company's Autometrology, Standard Production Instruments, and Fixed Gage and Inspection Instruments Divisions. J. T. WELCH, who has previously served as general manager of the Machine Tool Division, is named assistant vice-president for coordinating the operations of the company's national field sales organizations. WILLIAM I. WILT, formerly general manager of the Standard Production Instruments Division, has been advanced to assistant vice-president of this division.

JOHN F. CACHAT has been appointed works manager of the Ohio Crankshaft Tocco Division, Cleveland, Ohio. In his new capacity, Mr. Cachat will head Tocco's engineering and manufacturing activities.

EUGENE CALDWELL has been elected president of the Baker-Raulang Co., Cleveland, Ohio. He was formerly vice-president and general manager of the Hyster Co., Portland, Ore. Mr. Caldwell succeeds PERCY L. DOUGLAS who continues as a director of the company and executive vice-president of Baker's parent Company, Otis Elevator Co.

RALPH L. BOYER has been elected vice-president and director of engineering, Cooper-Bessemer Corporation, Mount Vernon, Ohio.

R. L. WILLIAMS has been appointed assistant chief engineer, Automotive Division, Timken Roller Bearing Co., Canton, Ohio.

Pennsylvania

JOHN H. DIEHL has been named assistant to the vice-president in charge of the Power Tool Division, Rockwell, Mfg. Co. He was formerly assistant works manager of Allis-Chalmers Mfg. Co., La Porte, Ind., works. He will make his headquarters temporarily at Rockwell's power tool plant in Bellefontaine, Ohio, before moving to Pittsburgh.

BALDWIN-LIMA-HAMILTON CORPORATION, Philadelphia, Pa., announces the following appointments: PERRY A. WHITE, general controller, has been appointed vice-president and general manager of the Eddystone Division, Eddystone, Pa. At the same time it was announced that ROBERT G. TABORS, vice-president and assistant general manager of the corporation's Hamilton Division, was named vice-president and general manager of the Electronics and Instrumentation Division, Waltham, Mass. Succeeding Mr. White as general controller is ROBERT P. BAUER, who has been controller at B-L-H, Lima, Ohio.

(*This section continued on page 270*)


(Left) Perry A. White, vice-president and general manager, Eddystone Division; and Robert G. Tabors, vice-president and general manager, Electronics and Instrumentation Division, Baldwin-Lima-Hamilton Corporation

Ex-Cell-O Style 43-A Method X Tool Sharpener uses inexpensive cast-iron disk in place of conventional, but costly, diamond-faced grinding wheel.

XLO EX-CELL-O FOR PRECISION

Ex-Cell-O Method X Tool Sharpener Cuts Carbides Without Expensive Wheels

Compare the cost! Diamond wheel cost in off-hand tool grinding runs *eight to twelve dollars* per cubic inch of carbide removed. Wheel expense with Method X averages *only 20 cents.*

Compare the work! Method X produces no thermal stresses—won't chip or score carbide tips. Both carbide and shank are removed simultaneously—no need grinding secondary clearances.

Compare the operation! Operators can handle Method X Machines without special training. No pressure on the workpiece means less operator fatigue. Cutting speed (comparable to diamond wheel grinding) and desired matte finish—simply a matter of setting a power selector switch.

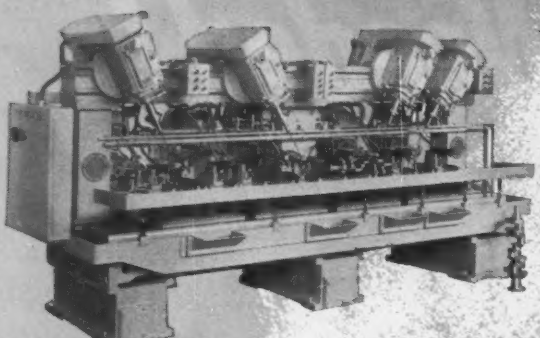
For full information on Method X send today for your copy of Ex-Cell-O's illustrated Bulletin #43272. Or ask your local Ex-Cell-O Representative for one.

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

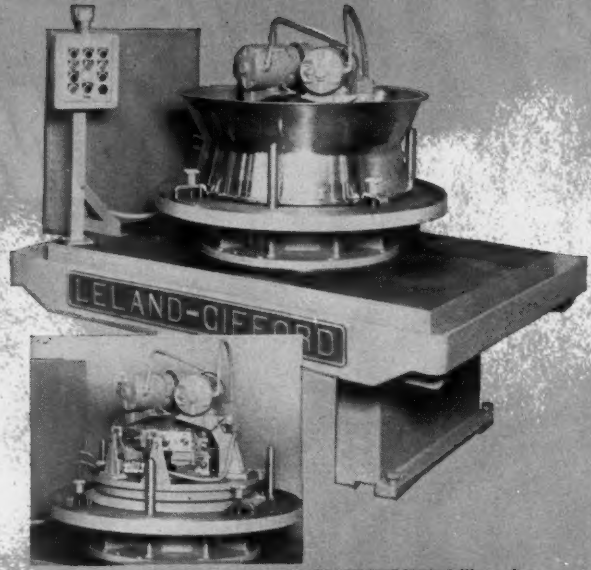
Machinery Division

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

57-40

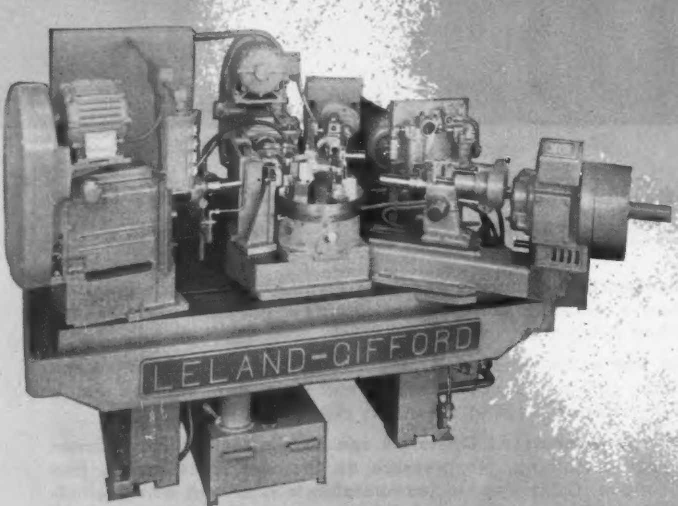


CRANKSHAFT OIL HOLE drilling machine. Four stations with self-contained units rail mounted for maximum flexibility of arrangement. Manually loaded with automatic clamping and release. Drills eight deep oil holes at 20 shafts per hour.

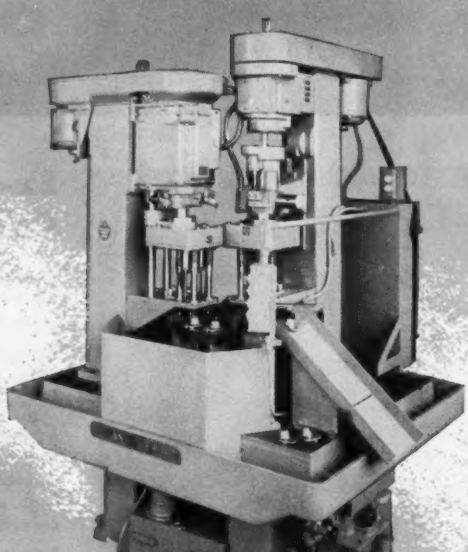


AIRCRAFT SPECIAL drills and reams 70 radial holes in a jet engine turbine case weldment at 3 pieces per hour. Insert shows tooling.

LELAND-GIFFORD

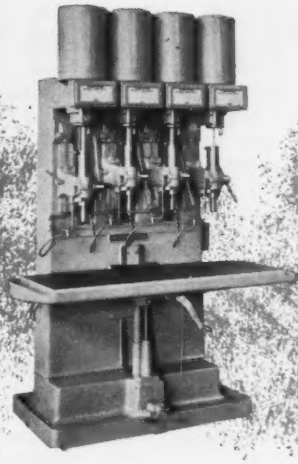


FUEL PUMP BODIES are drilled (13/64" x 1.54") and tapped (1/4-18) two holes each at 240 pieces per hour. Four self-contained units operate around a three-station indexing fixture.

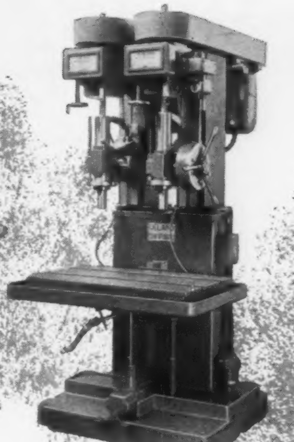


1400 PIECES PER HOUR. Suspension part dust caps are loaded two at a time in a four-station indexing fixture, drilled and tapped for a grease fitting, automatically ejected to chute and conveyor.

NEW HOLE LOCATOR for fast, accurate, jigless drilling with optical positioning from a simple, reusable layout chart.

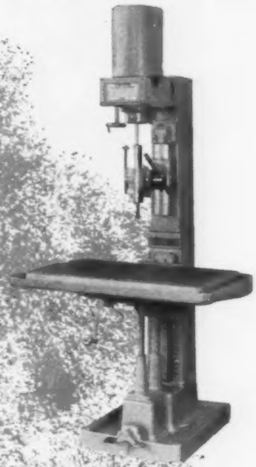


INDUSTRY'S STANDARD for precision drilling and tapping. No. 2LMS is available in one to six spindles; 20″ or 26″ swing; speeds up to 3600.RPM; hand, power or hydraulic feed.



FOR HEAVY DUTY DRILLING, No. 3MVB is available with eight speeds up to 1800 RPM; 24″ swing; one to four spindles; hand, power or hydraulic feed.

TOOLROOM DRILL PRESS. No. 2LMS has 26″ swing, oversize table, eight speeds, reversing motor for tapping. No. 3MVB with extra capacity also available.



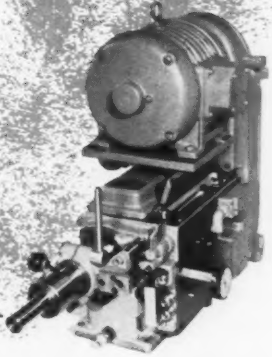
Drilling Machines

Representing more than 50 years of specialization in the manufacture of precision drilling equipment, the Leland-Gifford line includes:

STANDARD sensitive and hydraulic feed machines in a complete range of types and sizes including the Leland-Gifford Hole Locator for jigless drilling with optical positioning.

SPECIAL machines incorporating Leland-Gifford drilling units, multiple heads, indexing tables, quick-handling fixtures and other high production features.

Bulletins give complete information. Write for them . . . or contact the office near you.



SELF-CONTAINED UNITS. Four sizes for holes from .020″ to 1.500″. Furnished with motor, hydraulic pump and accumulator system; dual feed, step x step or plain feed.

TAPPING ATTACHMENTS for any Leland-Gifford machine. Handle class 3 holes with ease. Size No. 1 — up to 3/16″ capacity, 5000 RPM. Size No. 2 — up to 7/16″ capacity, 1200 RPM.

LELAND-GIFFORD COMPANY • WORCESTER 1, MASSACHUSETTS

Branch Offices.. CHICAGO 5, 2515 W. Peterson Ave. • CLEVELAND 22, P. O. Box 853 • DETROIT 21, 10429 W. McNichols Rd. • INDIANAPOLIS 6, P. O. Box 1051 LOS ANGELES, 2620 Leonis Blvd., Vernon 58, Cal. • NEW YORK, 75 S. Orange Ave., South Orange, N. J. • ROCHESTER 12, P. O. Box 24, Charlotte Station,

For more information fill in page number on Inquiry Card, on page 259

James S. Anderson, vice-president, Tubular Products Division of the Babcock & Wilcox Co.

James S. Anderson, formerly general sales manager of Tubular Products Division of Babcock & Wilcox Co., has been elected vice-president of the company in charge of sales for that division. Mr. Anderson will continue to make his headquarters in Beaver Falls, Pa. He joined the company in 1941 as a district salesman in the Division's New York office; was named assistant manager of that office the next year; and assistant general manager in 1948. He was promoted to sales manager in 1953.

William B. Downes, manager of Stainless Steel Division, Crucible Steel Company of America

William B. Downes has been appointed manager, Stainless Steel Sales Division, for the Crucible Steel Company of America, Pittsburgh, Pa. Mr. Downes has been assistant division manager for stainless steel sales for more than two years. In his new capacity, he will maintain over-all responsibility for sales of stainless steel products. He has been with the company for almost twenty-three years.

Dr. Walter A. Dean has been named assistant development metallurgist for the Aluminum Company of America, Pittsburgh, Pa.

John R. Onders has been named sales engineer for Wall Colmonoy Corporation Co.'s Pittsburgh, Pa., office.

Obituaries

Joseph B. Armitage, consultant vice-president at Kearney & Trecker, Milwaukee, Wis., since 1955, died on May 30 at the age of seventy-six years. Mr. Armitage joined the company in 1920 as chief engineer and held this position until 1943 when he was elected vice-president in charge of engineering. During his thirty-seven years with the company, he was credited with 121 patents in the machine tool field.

He was a member and director at large of the American Society of Mechanical Engineers, and in 1955, was named honorary member of that organization which carried with it a lifetime membership. He was past chairman of the Society of American Engineers, Milwaukee section, as well as a director and member of the Milwaukee Engineering Society, and held a membership in the Newcomen Society, a group devoted to the study of material history.

Joseph B. Armitage

Sir Alfred Herbert, K.B.E., chairman and managing director of Alfred Herbert Ltd., Coventry, England, died on May 26th at the age of ninety years. In 1894, his company was formed and Herbert machine tools soon gained acceptance in a wide field. For more than sixty years, under the guidance of Sir Alfred, the firm continued to grow in size and importance and has made many outstanding contributions to the machine tool industry. In addition to the work he did in developing his own company, Sir Alfred played an active part in furthering the growth and prestige of the machine tool industry in general.

Correct Address

In an item published in April Machinery, mention was made of "Erie Forge & Steel Corporation's Buffalo plant." The headquarters of this concern are in Erie, Pa., where it has been producing steel forgings and castings since 1872.

Coming Event

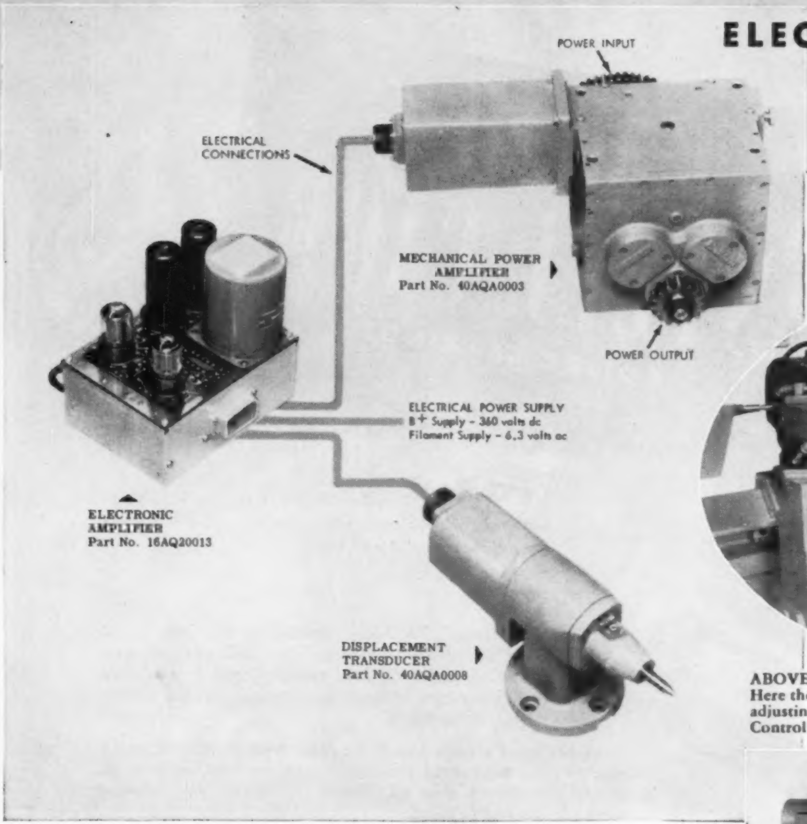
July 29-August 2—Annual Sales Conferences of Sales Executives, Advertising Managers, and Sales Engineers of member companies of the National Machine Tool Builders' Association and the American Tool Distributors' Association to be held at Cornell University, Ithaca, N. Y. For further information contact Hill & Knowlton, 323 Republic Building, Cleveland 15, Ohio.

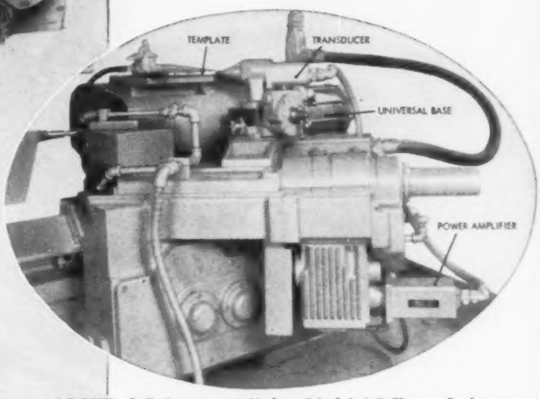
* * *

Safety Awards to Tool and Die Shops

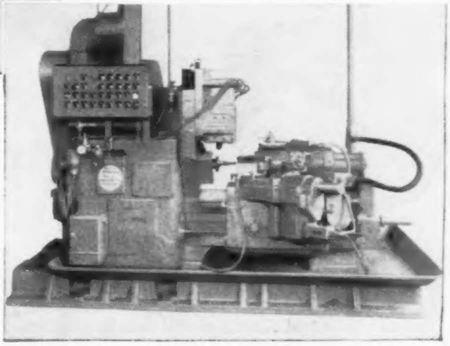
The National Tool & Die Manufacturers Association has presented awards to 288 member plants for outstanding safety records compiled in 1956. In the second annual Safety Contest held by the group, 260 members earned a Gold Award for having an accident frequency rate of less than 60 per cent of the average for the contract tool and die industry in 1956. Of these plants, 244 had an accident-free year. An additional 28 members won a Silver Award for showing an improvement over their 1955 frequency rate.

PERFORMANCE ASSURED WITH SENECA FALLS ELECTRO-MECHANICAL CONTROLS

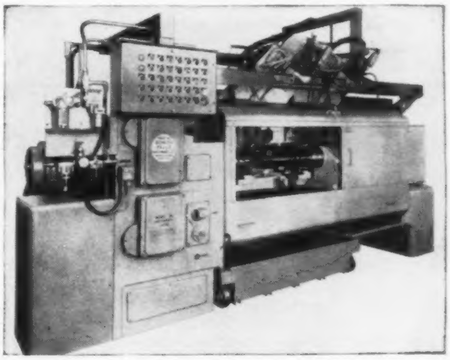




ABOVE: S. F. System applied to Model AP Tracer Lathe. Here the Transducer is mounted on a universal, micrometer-adjusting base. The Electronic Amplifier is housed in the Control Cabinet. **BELOW**: Overall view of same machine.



BELOW: Seneca Falls Model Q Tracer Lathe with four carriages controlled by the S. F. System.



▶ This patented Seneca Falls System, now available to industry, consists of a Displacement Transducer having built-in switches for sensing both initial actuation and overtravel of the stylus; an Electronic Amplifier; and a Mechanical Power Amplifier providing up to one H. P. of control output. The Power Amplifier takes its power from a constantly revolving shaft and drives the load in accordance with the original sensing signal. The system will reposition within $\pm.0002''$ and can be used for both single and two dimension control.

This Displacement Transducer may be replaced by any standard AC signal source for controlling the Mechanical Power Amplifier. Such source can provide for manual or automatic control from process control transducers, velocity transducers or computer systems.

Write for technical data, preferably with full information about your control problem.

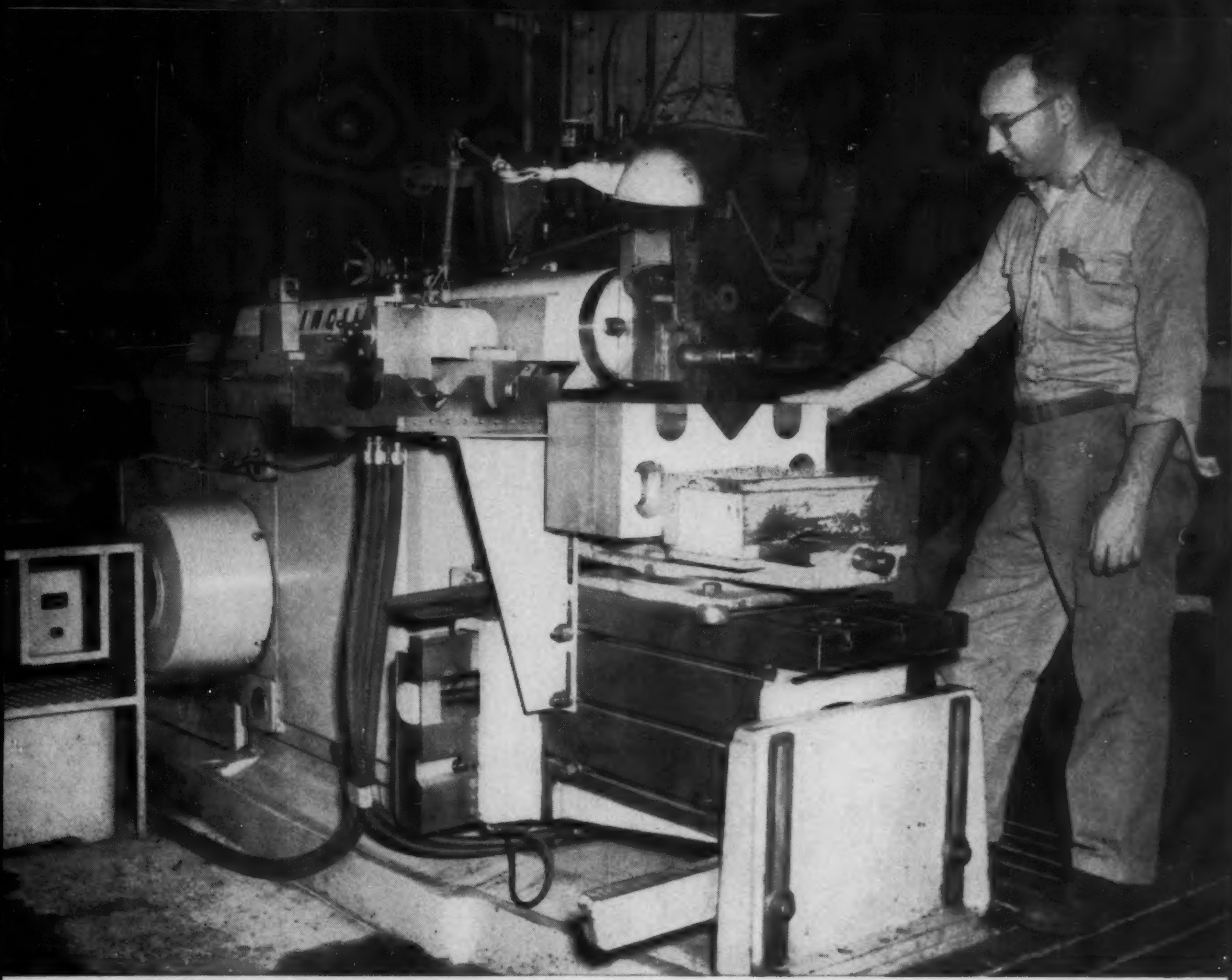
SENECA FALLS MACHINE

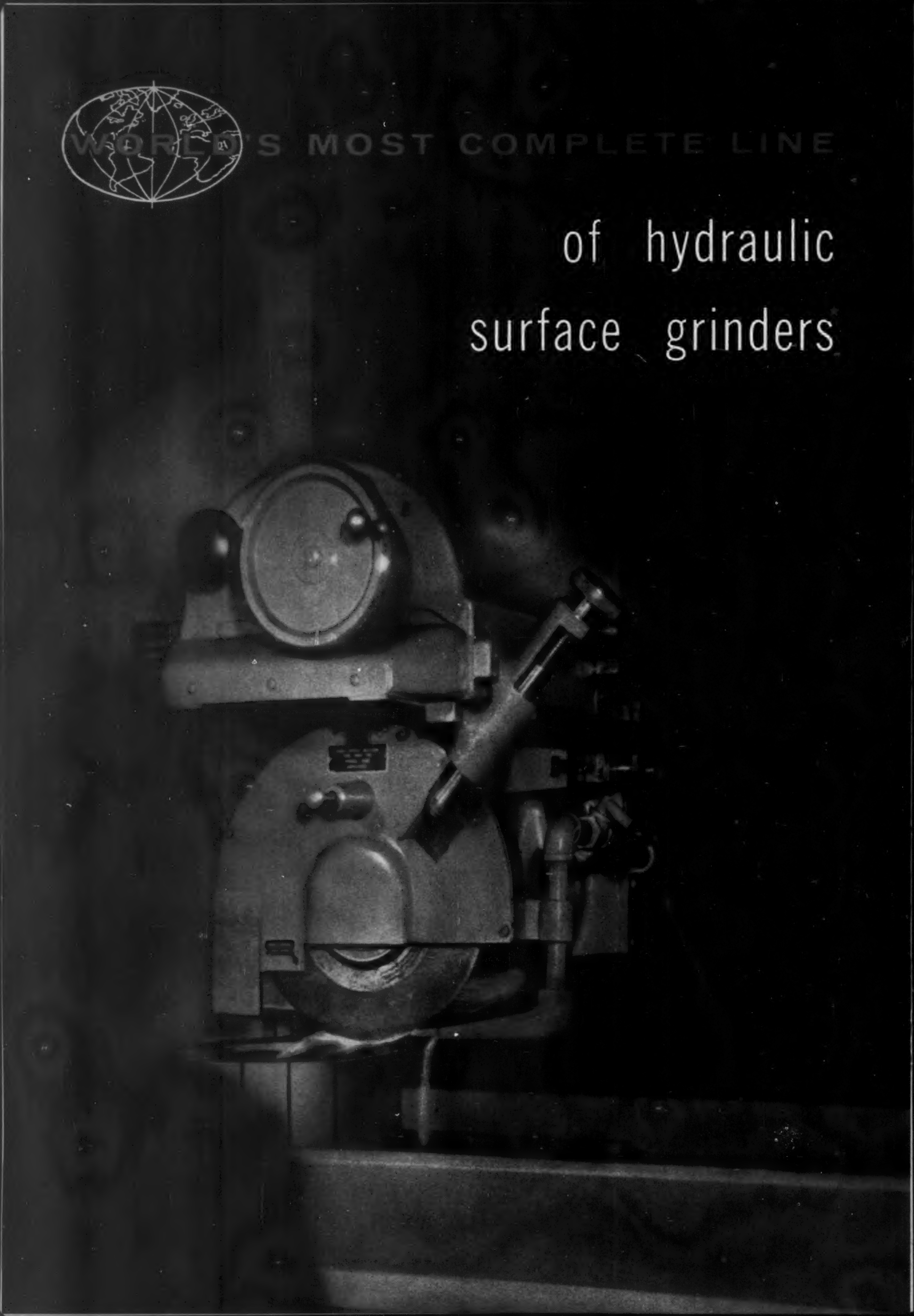
MACHINE TOOLS SINCE 1864

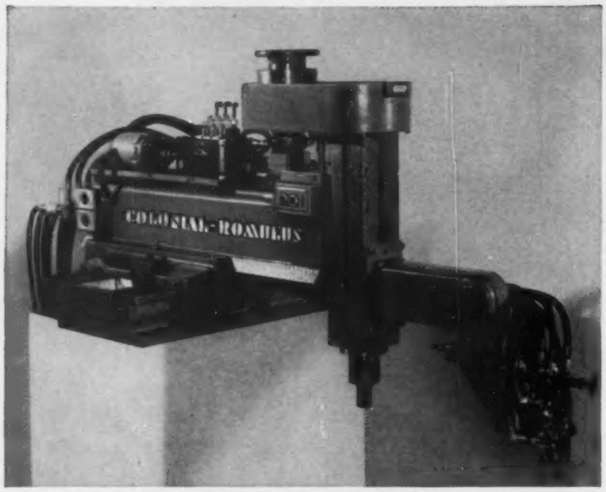
SENECA FALLS MACHINE CO.
Seneca Falls, New York

Automatic and Semi-automatic Lathes • Automatic Drilling and Centering Machines
Automatic Work Drivers • Production Tracer Lathes • Automation and Work Handling Devices • Special Production Machinery

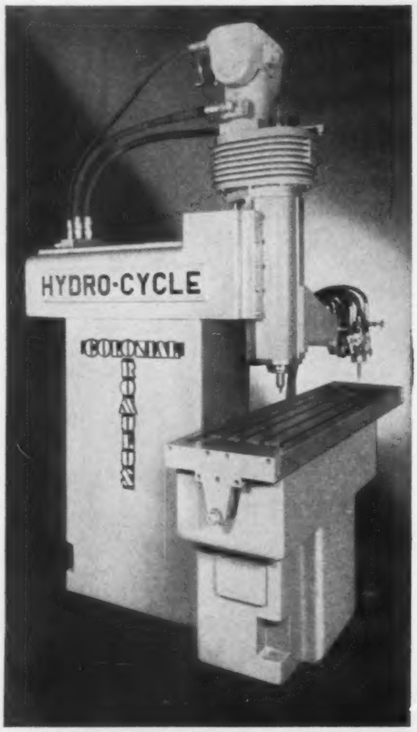
For more information fill in page number on Inquiry Card, on page 259




WORLD'S MOST COMPLETE LINE
of hydraulic
surface grinders



3 New Lines for Faster, Lower-Cost Tracer Milling



Dupli-Mill Milling Unit (top) . . .

in several sizes for easy positioning in individual or line setups. Completely self-contained machine . . . duplicating units with integrated tracers. Inexpensive, the units are proven work horses in long- or short-run production. Template guided by pencil-type tracer. Sizes range from 12x12 to 36x36 inches of longitudinal and cross travel. Ask for Bulletin CRH-57.

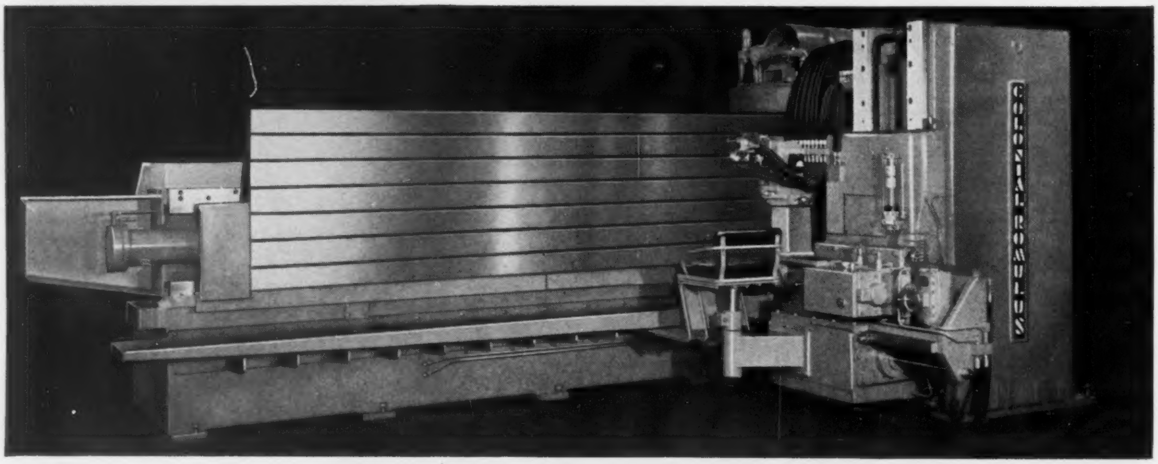
Hydro-Cycle Mills (center) . . .

manually controlled precision contour mills for both aircraft plants and die shops. Available in two series of sizes: the first to 48x18 inches; the second series to 96x28 inches which can be supplied with multiple spindles. Infinitely variable spindle speeds with constant horsepower at any speed. High machine rigidity for heavy cutting or delicate work. Write for Bulletin CRH-57.

Sculpture Machines (bottom) . . .

for easier contour and profile milling of aircraft and missile parts. Several sizes available to suit different applications. Infinitely variable cutter speeds (from 40 to 3000 rpm). Easy to set up, operate and maintain to consistently high accuracy. Template and work clearly visible at all times. Chips fall free. Bulletin CR-56 gives full details.

COLONIAL-ROMULUS DIV.
COLONIAL BROACH & MACHINE CO.
PARKGROVE STATION • DETROIT 5, MICHIGAN



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Will PRODUCTION LAPPING Prove Beneficial in MY Plant?

Get The Answer With

YOUR OWN FREE ANALYSIS

FROM THE Lapmaster® TECHNICAL SERVICE

It's easy to prove to yourself whether production lapping will benefit your own manufacturing process...improve your product performance. Just send a few sample parts with surface finish specifications and production requirements to the Lapmaster Technical Service.

We'll test run them in our experimental lapping laboratory and furnish you with a full production report. This complete special analysis will give everything you need to determine how profitable the Lapmaster will be in your plant. Lapped samples will enable you to positively check product improvement.

More than 80% of the successful Lapmaster installations now in daily operation started with just such an analysis . . . and in the majority of cases, the results have shown substantial savings. However, if the application is not practical or profitable for you, we are frank to report it.

View of our experimental lapping laboratory showing some of the equipment available to test run your sample parts.

Our lapping laboratory is also equipped with the finest checking instruments to insure an accurate report of every experimental job.

TECHNICAL BULLETINS FOR YOU—If you want additional information immediately, write for these latest technical bulletins on producing and measuring precision flatness and finish.

WHAT YOU CAN EXPECT FROM A LAPMASTER

- Surface finishes of 2 to 3 RMS and surface flatness within tolerances of .0000116" with absolute uniformity piece after piece.
- No production bottlenecks frequently caused by other lapping methods.
- No downtime for truing lap plate . . . conditioning rings automatically keep plate flat and true.
- Product performance and quality improved . . . rejects cut to a minimum . . . inspection costs reduced.

Crane Packing Company, 6433 Oakton St., Morton Grove, Ill. (Chicago Suburb)

In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

CRANE PACKING COMPANY

For more information fill in page number on Inquiry Card, on page 259

. . . Fluid Power **news**

NEW HEAVY DUTY CYLINDERS

NOW AVAILABLE—New Oilgear "Custom-Quality" Line of Heavy-Duty, 3,500 psi Cylinders

✓Check . . . Compare these 20 "Custom-Quality" features:

1 Four-bolt, face-mounted steel pipe flanges—straight, angle, or multiple port . . . pipe taps, straight taps, or sockets for welded connections available in various sizes.

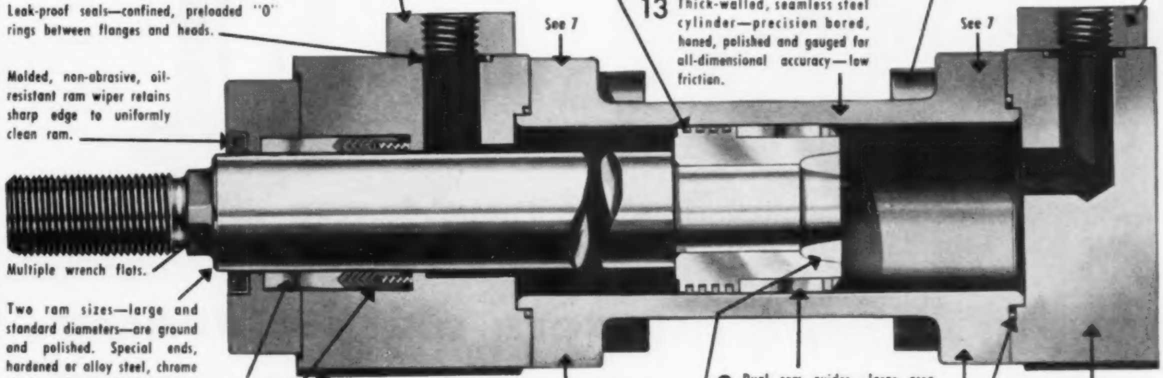
14 Four closely fitted, automotive-type piston rings are retained in precision-cut piston grooves for effective sealing and exceptionally long life.

12 Short steel tie bolts—eliminate axial tension or compression load on cylinder. Either head can be removed independently without disrupting entire cylinder.

2 Leak-proof seals—confined, preloaded "O" rings between flanges and heads.

13 Thick-walled, seamless steel cylinder—precision bored, honed, polished and gauged for all-dimensional accuracy—low friction.

3 Molded, non-abrasive, oil-resistant ram wiper retains sharp edge to uniformly clean ram.



4 Multiple wrench flats.

5 Two ram sizes—large and standard diameters—are ground and polished. Special ends, hardened or alloy steel, chrome plating also available on request.

6 Spring-loaded, "V" type molded ram packing for automatic sealing action—low uniform friction. Independent face-mounted bushing gland prevents tightening or binding.

7 Machined steel flanges welded to cylinder for greatest rigidity. Permit sealed, face-mounting of heads—eliminating loose flanges, grooves, split-ring retainers, dirt gaps.

8 Piston is pressed and welded to ram for absolute concentricity, longest life, strength, rigidity—eliminates threads, seals, spacers, lock pins, etc.

9 Dual ram guides—large area bronze bushings in front heads and on pistons give proper end support, resist side thrusts and ram sag.

11 Machined, bar steel heads—rugged, shock-resistant. Extra large passages reduce fluid velocity.

10 Leak-proof static and pressure seals—confined, preloaded "O" rings between cylinder flanges and heads. Face-mounting eliminates high initial bolt stress, compression or tension distortion.

15 Adjustable hydraulic cushions—dash pots—for front, rear, or both heads. New, exclusive Oilgear floating-sleeve design assures superior performance, longer life, less wear—eliminates check valves.

16 Eight basic sizes—2", 2½", 3¼", 4", 5", 6", 7", 8" . . . length of stroke varies from 36" to 158". Longer stroke available on request.

17 Air vent plugs, double end rams, special ram ends, special packings for use with fire-resistant fluids are also available.

18 Choice of fixed mountings—foot lug, center lug, or flange—can be combined or interchanged, front or rear, to suit any requirement.

19 Choice of hollow trunnion mountings—rear, center, front—accurately machined, integral with heads. No hoses or slide joints—Oilgear's exclusive steel flange connectors—rugged, leak-proof, rotate smoothly.

20 Designed and built to the highest standard of quality for the most dependable, trouble-free, long life. Machinery builders and users alike, say—"For the lowest cost per year—it's Oilgear!"

Complete user satisfaction is guaranteed by Oilgear's extensive research, testing, over 35 years of design, manufacturing, and application experience in the field of Fluid Power—both oil and fire-resistant fluids.

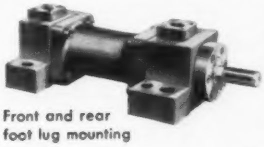
For further information on these new cylinders, call your Oilgear Application-Engineer. Or write for bulletins 73000 and 73245 directly to . . .

THE OILGEAR COMPANY

Application-Engineered Fluid Power Systems

1569 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

STANDARD MOUNTINGS



Front and rear foot lug mounting

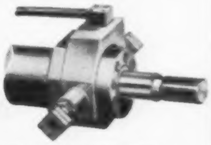
Front and rear center lug mounting

Heads can be combined or interchanged

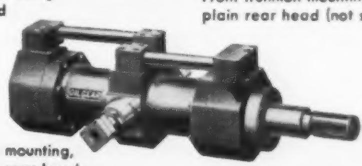
Rear flange mounting plain front head

Front flange mounting plain rear head

Rear trunnion mounting plain front head



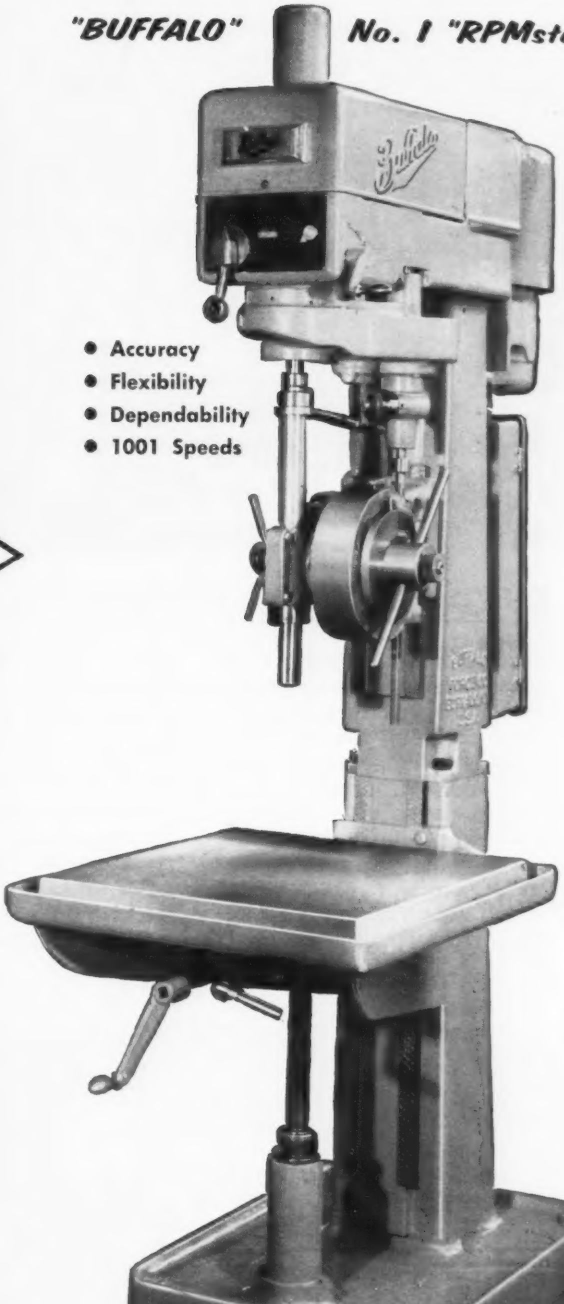
Front trunnion mounting plain rear head (not shown)



Center trunnion mounting, plain front and rear heads

FAVORITE OF THE AIRCRAFT INDUSTRY

"BUFFALO" No. 1 "RPMster"



"Buffalo" No. 18 DRILL

- Accuracy
- Flexibility
- Dependability
- 1001 Speeds

machine tools quality standards

The "Buffalo" No. 1 "RPMster" is the ultimate in drilling machines for the aircraft builder. It has achieved industry-wide fame for its quick-change variable speed drive, its accuracy, durability and versatility.

Outstanding "RPMster" features are the clean, streamlined design — the neatness and accessibility of all controls — the vibration-free operation — the fine balance of the drive. The two handles at the front of the head assure easy speed changes, infinitely variable throughout both high and low ranges. Not until you've tried the "RPMster," will you know what smooth and vibration-free drill operation you can command. Call your nearest "Buffalo" Representative for a demonstration — or write for Bulletin 3967-A.

COMPANY 440 BROADWAY · BUFFALO, N. Y.

Co., Ltd., Kitchener, Ont.

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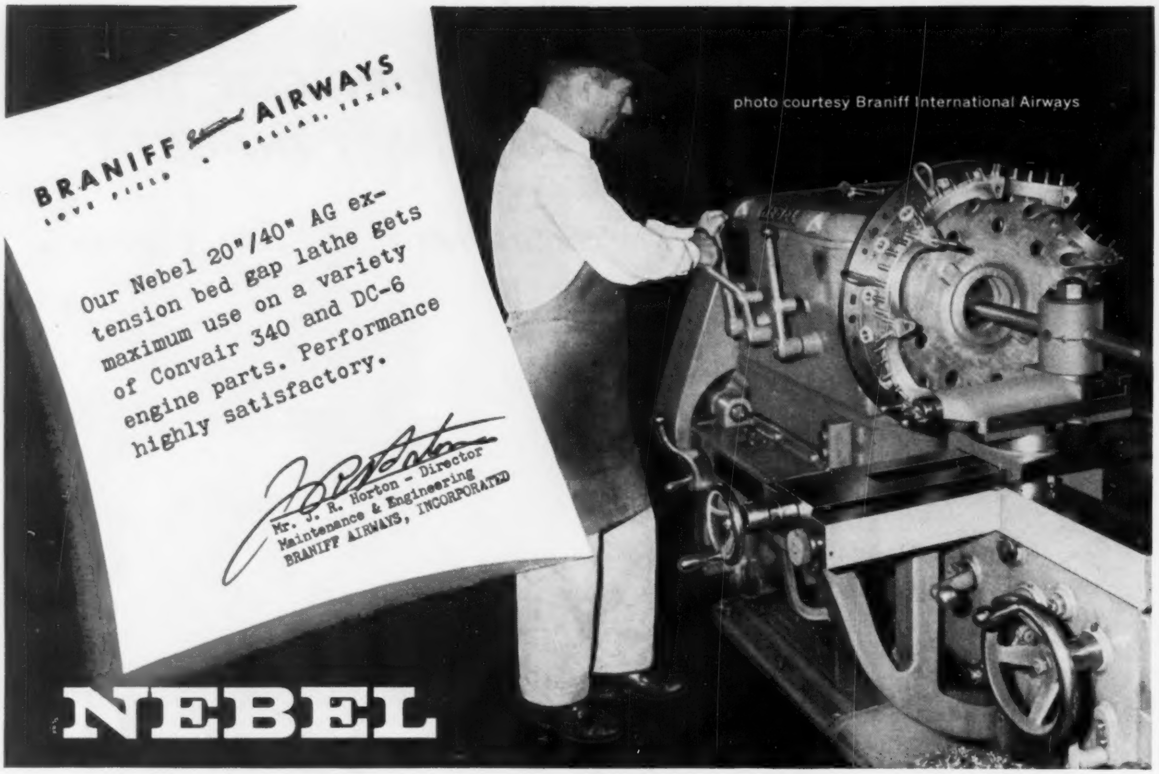


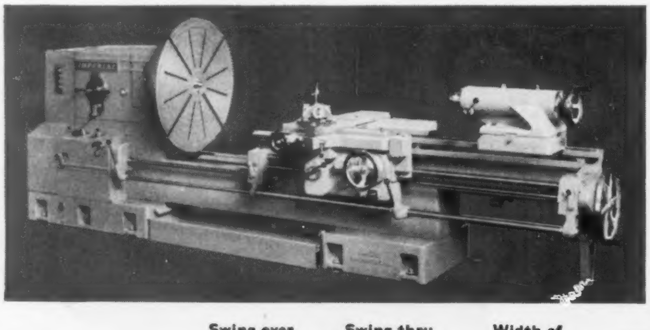
gap lathes perfect for aviation machine shops

Aircraft manufacturers and operators are finding Nebel extension bed gap lathes the most useful tools in the machine shop. The sliding upper bed opens up a wide, deep gap that accommodates parts like the R-2800 engine case shown above... landing gear struts for the DC's (6, 7 & 8) ... parts for the new Viscount, world's first turbo-prop airliner... and many other outsize, odd-shaped parts.

And with the gap closed, the lathe will turn all your standard lathe work as well.

You benefit enormously from the capacity, speed, power and performance these productive lathes offer. Made in three different models and many sizes (see below), there's a Nebel gap lathe that will fit your requirements exactly.

Nebel also manufactures removable block gap lathes, 16"/27", 20"/30" and 25"/50" swing sizes; and engine lathes 16" to 36". For complete information, send today for descriptive bulletins. Nebel Machine Tool Corp., 3410-A Central Parkway, Cincinnati 25, Ohio.



Nebel's double duty gap lathe/standard lathe feature means low capital investment and more efficient use of floor space. These versatile lathes have been welcomed for production and maintenance machining by these aircraft manufacturers and airlines:

North American Aviation, Inc. — Hughes Aircraft Co.
Braniff International Airways — Solar Aircraft Co.
Eastern Air Lines, Inc. — Capital Airlines
Pan American World Airways System

Nebel Extension Bed Gap Lathes

Nebel offers a complete range of models and bed lengths. You're sure to get exactly the type and size you need.

	Swing over ways	Swing thru gap	Width of gap*	Bed length† Minimum	Bed length† Maximum	Spindle speeds range, rpm	Motor Recommended
Imperial 20"/40"	24½"	42"	32"	8 ft.	30 ft.	11-666 or 16-1000	15-20
AG series 20"/40"	22½"	40"	24"	6 ft.	20 ft.	9-280 or 16-500	7½-10
G series 28"/50"	29"	52"	41"	10 ft.	30 ft.	5-230 or 10-460	20-25

*on shortest bed length

†increasing in increments of 2 ft.

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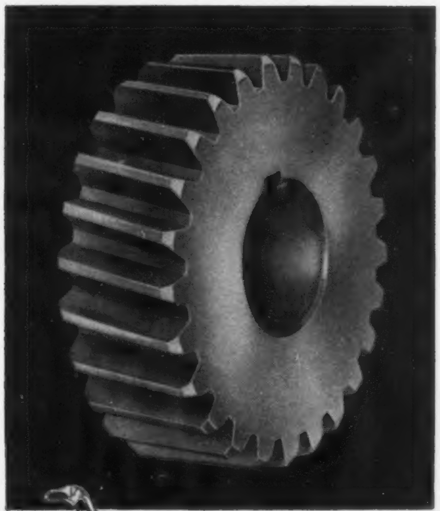
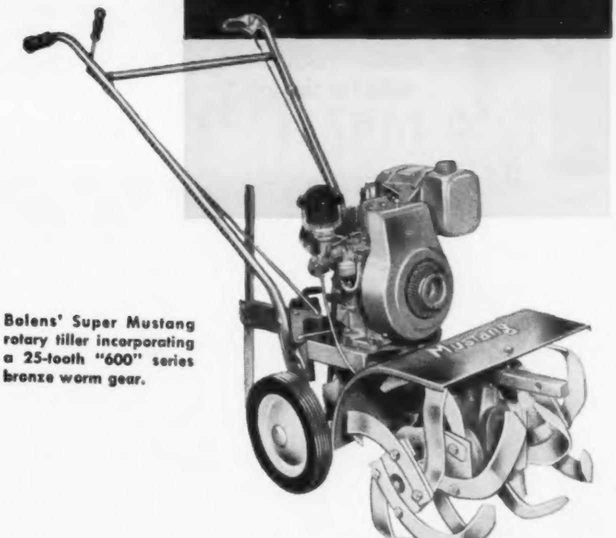
For more information fill in page number on Inquiry Card, on page 259

and TILLERS prove

CO.





Bolens' Super Mustang rotary tiller incorporating a 25-tooth "600" series bronze worm gear.

- WRITE TODAY FOR THE ENGINEERING MANUAL YOU NEED

Mueller Brass Co. Forgings Engineering Manual H-58565 ☐

Tuf Stuf Aluminum Bronze Alloys Engineering Manual H-58563 ☐

"600" Series Bearing Alloys Engineering Manual FM-3000 ☐

Copper Base Alloys in Rod Form Engineering Manual FM-3010 ☐

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METALS AND ALLOYS REVIEW

by FRANK M. LEVY

Vice-President and Director of Research

One of the most interesting things about our 600 series bearing alloys is the great variety of products in which they find application. In the advertisement to the left you can see how the Bolens people put 600 gears to work in their rotary tillers and garden tractors. Those gears are big, take a lot of abuse, and meet the job needs perfectly. We also make a lot of small parts, too, that have been specified because of the many unusual properties of this series of alloys.

One good example that comes to mind is a shaft bushing on a rotary selector switch that we make for an instrument manufacturer. This selector is used for switching sound-powered telephone circuits aboard Naval vessels. One of the most important considerations in the choice of 600 alloy for this bushing was its resistance to abrasive action on and against a rubber "O" ring. The acceptance test required a stainless steel shaft riding in the bushing to rotate "dry" for a minimum of 50,000 cycles consisting of 360° rotation clockwise followed by a 360° rotation counter-clockwise. The "O" ring must still form a watertight seal at the end of the test. Our 602 alloy was the only one of several materials tested that met the specs. That was pretty good evidence in itself of resistance to abrasion, but, in addition, this customer also found that the use of 602 eliminated the headaches they previously had with seizing and galling.

The pounding action caused by the indexing mechanism attached to the shaft used to give them no end of seizing troubles. The chief product engineer is extremely happy about the way our alloy is performing. Mention was also made of the fact that the corrosion resistance of 602 was mighty impressive. In this application, the alloy passed the 200-hour Navy salt spray test with flying colors.

So, big or small, it seems that there is no end of applications for 600 series alloys. We even have parts working in a machine that slices frankfurters as well as gears in fishing reels. So, it seems that 600 runs the gamut from "red hots to reels". Well, it looks like the end of the page is here again, so I'll close for now. However, if you have any problems or questions about non-ferrous alloys or you're having trouble getting desired performance from a part, why not drop me a line here in Port Huron, and possibly I can be of some service. Send a part print along if you like, and we'll be glad to make proper recommendations.

Thanks again for your time.

MUELLER BRASS CO.

PORT HURON 27, MICHIGAN

For more information fill in page number on Inquiry Card, on page 239

here's how Seeburg matches P-K® fasteners to the job

And Parker-Kalon's wide range of types and sizes makes it possible

"By carefully selecting the right P-K screw for each assembly we've reduced rejects and stepped-up production," says Joseph Kamys, engineer of J. P. Seeburg, manufacturers of the famous line of Select-O-Matic "200" Coin Operated Phonographs.

◂ "Take the fastening of metal kickplates and base moldings to wood cabinets, for example. They must hold permanently and go in fast without splitting the wood. P-K Type-A Self-tapping Screws are just right for the job."

"In a metal-to-plastic application such as the fastening of high-frequency speakers to formed plastic housings—P-K Type-Z thread-forming Screws go in right without cracking the plastic—stay put, even under high vibration." ▸

◂ "In this important subassembly, appearance is important as well as dependable holding power. Here we use P-K Type-A Phillips Recessed Head Screws in a metal-to-metal application."

Whatever your product or application . . . ferrous or nonferrous castings, sheet metal or structural steel, plywoods, asbestos compositions, pliable or brittle plastics . . . Parker-Kalon can furnish the proper fastener to speed assembly, reduce rejects, cut costs!

PARKER-KALON®
fasteners

Sold Everywhere Through Leading Industrial Supply Distributors.

***PARKER-KALON DIVISION**, General American Transportation Corporation. Factory: Clifton, New Jersey.*

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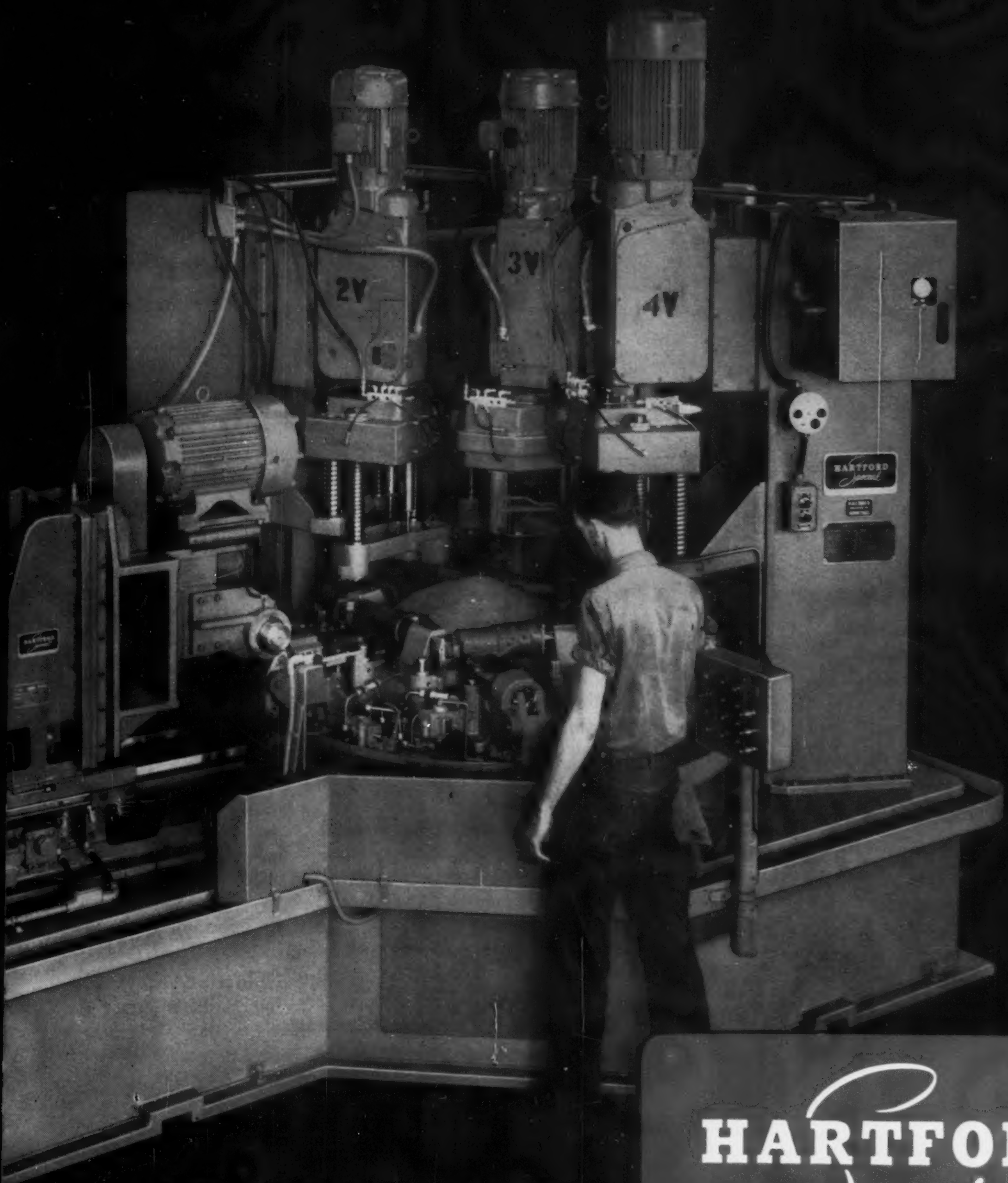
... ..Created by *Hartford Special*

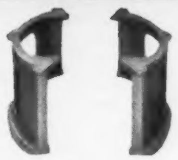


Hartford also makes automatic Thread Rolling Machines and the world famous Super-Spacer.

HARTFORD Special

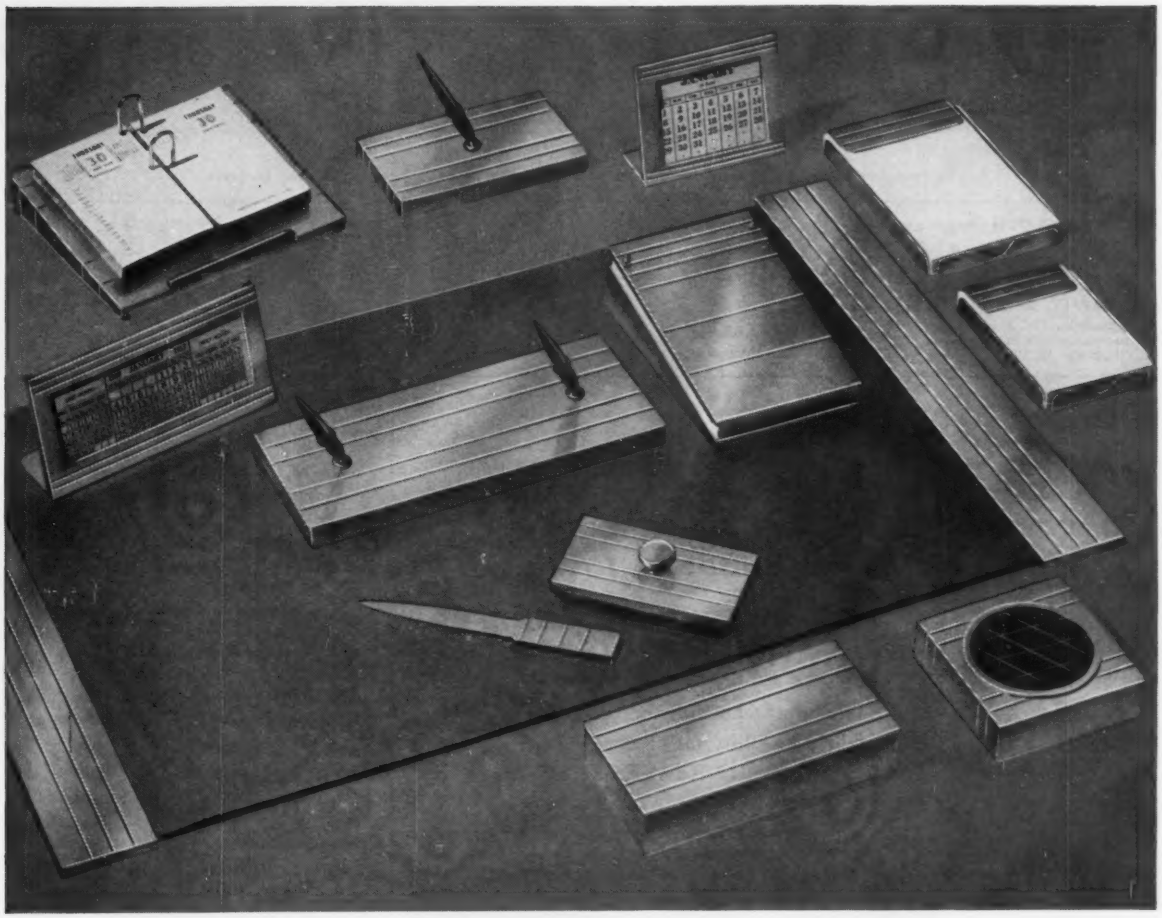
CIRCULAR BASE TOP

INDEX TABLE SUPPORT



PEDESTALS

MACHINE TOOL DIVISION
THE HARTFORD SPECIAL MACHINERY CO.
2907 HOMESTEAD AVE., HARTFORD 12, CONN.



A few of the fine executive desk appointments made of Formbrite by Smith Metal Arts Co., Inc.

For a superfine luster that lasts—superfine-grain Formbrite

Smith Metal Arts Co. uses easy-to-polish, scratch-resistant Formbrite to add value to its line of distinguished desk appointments.

The fine executive desk appointments made by Smith Metal Arts Co., Inc., Buffalo, N. Y., are not just polished to shine. They are brought up to a beautiful deep luster. For their line of brass accessories they use Formbrite,® Anaconda's superfine-grain drawing brass.

They have found that the fine, uniform grain size of Formbrite enables them to give their pieces a superior, more uniform texture. The luster, furthermore, stands up better under handling because Formbrite provides a harder, more scratch-resistant surface.

In order to achieve this fine luster, Smith Metal Arts Co. must do an exceptional amount of polishing and they have chosen Formbrite because of its superior polishing characteristics. By using Formbrite they can achieve their high quality surfaces at savings of 20% over the use of ordinary brass.

See for yourself. Formbrite is a premium product at a nonpremium price. Find out for yourself how its superfine grain, excellent drawing properties, strength, and scratch resistance can help you improve product quality, lower finishing costs. Write for Publication B-39. Better yet, ask for a sample or details on our trial order offer. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5771

Formbrite

SUPERFINE-GRAIN DRAWING BRASS

an ANACONDA® product

Made by The American Brass Company

Product Directory

To find headings easily, look for capital letters at top of each page to denote location.

ABRASIVE CLOTH, Paper and Belt
Carborundum Co., Niagara Falls, N. Y.
Crane Packing Co., Morton Grove, Ill.
Gardner Machine Co., Beloit, Wis.
Macklin Co., Jackson, Michigan
Norton Co., 1 New Bond St., Worcester, Mass.
Simonds Abrasive Co., Tacony and Fraley Sts., Bridesburg, Philadelphia, Pa.

ABRASIVES, Discs
Carborundum Co., Niagara Falls, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Crane Packing Co., Morton Grove, Ill.
Macklin Co., Jackson, Michigan
Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony and Fraley Sts., Bridesburg, Philadelphia, Pa.

ABRASIVES, Polishing, Tumbling, Etc.
Carborundum Co., Niagara Falls, N. Y.

ACCUMULATORS, Hydraulic
Watson-Stillman Co., Roselle, N. J.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

AIR GAGES, Dimensional—See Gages Air Comparator

AIR GUNS
Chicago Pneumatic Tool Co., New York 17, N. Y.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

AIR TOOLS—See Grinders, Portable, Pneumatic Drills, Portable, Pneumatic, Etc.

ALLOY STEELS
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Columbia Tool Steel Co., Chicago Hts., Ill.
Crucible Steel Co. of America, Oliver Bldg., Pittsburgh 30, Pa.
Firth Sterling Inc., 3113 Forbes St., Pittsburgh 30, Pa.
Ryerson Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div., 436 7th Ave., Pittsburgh, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

ALLOYS, Bearing
Bunting Brass & Bronze Co., 715 Spencer Toledo 1, Ohio
Carpenter Steel Co., 105 W. Bern St., Reading, Pa.
Crucible Steel Co. of America, Henry W. Oliver Bldg., Mellon Square, Pittsburgh 22, Pa.
Mueller Brass Co., Port Huron, Mich.

ALLOYS, Non-ferrous—See Brass, Copper, Zinc and Stellite

ALUMINUM and Aluminum Products
Mueller Brass Co., Port Huron, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson & Son, Jos. T., 16th & Rockwell Sts., Chicago 8, Ill.

ANGLE PLATES—See Set-Up Equipment

ANNEALING FURNACES
Eisler Engrg. Co., 750 So. 13th St., Newark 3, N. J.
General Electric Co., Schenectady, N. Y.
Holcroft & Co., 6545 Epworth Blvd., Detroit 10, Mich.

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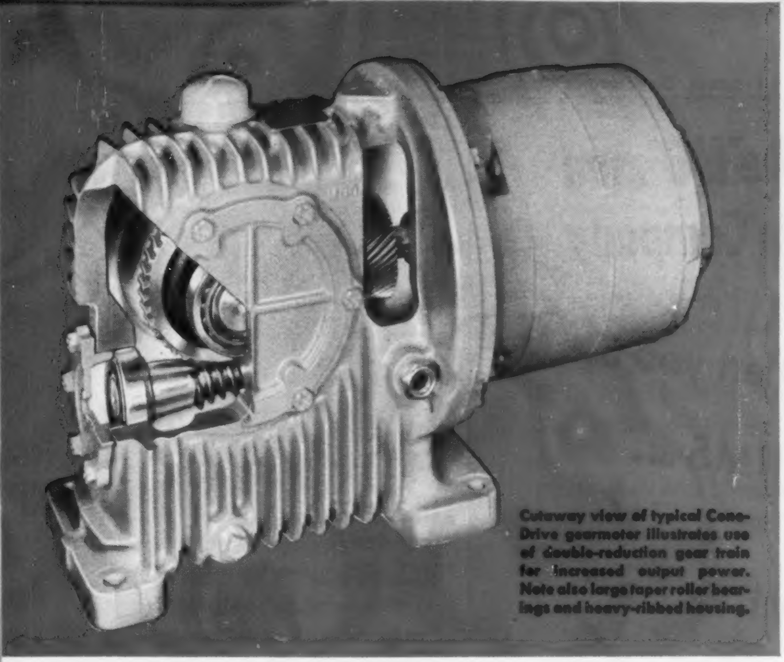


Cutaway view of typical Cone-Drive gearmotor illustrates use of double-reduction gear train for increased output power. Note also large taper roller bearings and heavy-ribbed housing.

Announcing a

POWERFUL NEW DRIVE

by

CONE-DRIVE GEARS

Here are the "why's" for this new gearmotor

Why a right-angle gearmotor?
You save space! By tucking the entire unit in close to the driven shaft, there's nothing to stick out in crowded aisles. It's out of the way.

Why a double-reduction design?
More power! Combining a helical primary with a Cone-Drive double-enveloping worm gear secondary gives you an extremely high load-carrying capacity. Output torque ratings are much higher than those of single reduction gearmotors. Overall ratios are greater, too.

Why double-enveloping worm gears?
More power! Cone-Drive double-enveloping worm gears have proven that they provide maximum load carrying capacity on extremely small center distances. This means, in many cases, that they will handle two to four times the load of cylindrical worm gears of the same size. An added plus is high resistance to shock loads, long operating life and minimum maintenance requirements.

Why different types of mountings?
Flexibility! You can select Cone-Drive gearmotors with extended shaft or for shaft mounting. Both are standard. Shaft mounting often permits "hanging" the driven load on the gearmotor to eliminate pillow blocks, bearings, torque arms, shafts, pulleys, bed plates, etc. Both types may be floor, wall or ceiling mounted as desired.

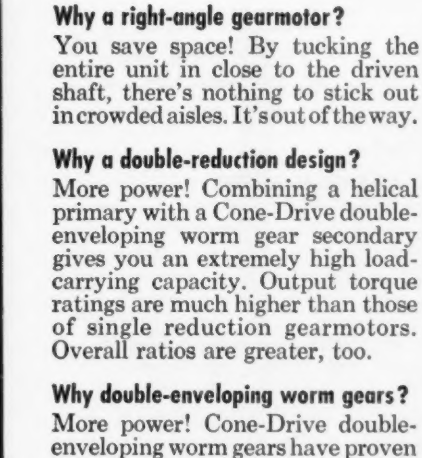
Why 27 standard output speeds?
Standardization! Standard reductions range from 3.3:1 to 240:1. Speeds at 1750 rpm input range from 525 rpm to 7.3 rpm output speed. Any variation in input speed will naturally provide another complete set of 27 output speeds. Any standard type NEMA D-flange motor may be used. Other reductions may be obtained on special order at additional cost.

Why ratings to only 25 horsepower?
Demand! Extensive market research by Cone-Drive Gears reveals that this is the most popular power range in the application of gearmotors by industry. Currently we are building models in capacities from 1 to 25 horsepower. However the compact size and high capacity of the Cone-Drive gearmotor will extend this range in the future. Space requirements for higher capacities will be substantially reduced with our new design.

Why a Cone-Drive gearmotor?
Dependability! For over 20 years Cone-Drive Gears has been building double-enveloping worm gears and speed reducers. Design and manufacturing techniques have been constantly improved so that today these unique gears provide, size for size, the highest load-carrying capacity of any right angle worm gearing. Now, you can take advantage of this outstanding gearing combined into an integral package that eliminates pulleys, sheaves, belts, chain, bearings and all the trouble that goes with separate reducer and motor combinations. You'll get increased efficiency at lower cost by specifying standard Cone-Drive gearmotors.

Bulletin #57 contains complete details. Ask for it today.

CONE-DRIVE GEARS
Division, Michigan Tool Company
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
7171 E. McNICHOLS ROAD • DETROIT 12, MICHIGAN



◀ Here's the finest shaft mounted gearmotor on the market today. It is available in all sizes with ratings identical to other Cone-Drive gearmotors.

ARBOR PRESSES—See Presses Arbor

ARBORS AND MANDRELS

Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
Jacobs Mfg. Co., West Hartford, Conn.
Kearney & Trecker Corp., Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
South Bend Lathe Wks., South Bend 22, Ind.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

ARC WELDERS—See Welding Equipment, Arc

ASSEMBLING MACHINES

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Robbins, Omer E. Co., 24800 Plymouth Rd., Detroit 39, Mich.

AUTOMATIC SCREW MACHINES—See Screw Machines, Single- and Multiple-Spindle Automatic

BABBITT

Ryerson, Jos. T., & Son, 2558 W. 16th St., Chicago 18, Ill.

BALANCING EQUIPMENT

Gisholt Machine Co. (Static and Dynamic), 1245 E. Washington Ave., Madison 10, Wis.
LaSalle Tool, Inc., 3840 E. Outer Dr., Detroit 34, Mich.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mach. Tool Co., 2531 11th St., Rockford, Ill.

BALL-MAKING MACHINES

New Departure Div., Bristol, Conn.

BALLS

Haynes Stellite Co., Kokomo, Ind.

BAR MACHINES—See Screw Machines, Single- and Multiple-Spindle, Automatic

BAR STOCK, Non-ferrous

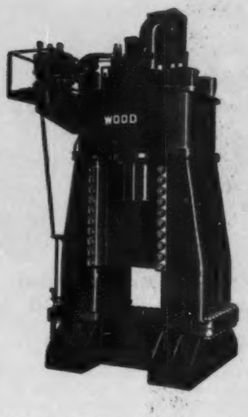
American Crucible Prod. Co., Port Huron, Mich.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio.
Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio.
Mueller Brass Co., Port Huron, Mich.
Ryerson, Jos. T., & Son, 2558 W. 16th St., Chicago 18, Ill.

BAR STOCK AND SHAFTING, Steel

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Carpenter Steel Co., 105 W. Bern St., Reading, Pa.
Crucible Steel Co. of America, Henry W. Oliver Bldg., Mellon Sq., Pittsburgh 22, Pa.
Cumberland Steel Co., Cumberland, Md.
Ryerson, Jos. T., & Son, 2558 W. 16th St., Chicago 18, Ill.

BEARING PILLOW BLOCKS AND CARTRIDGES

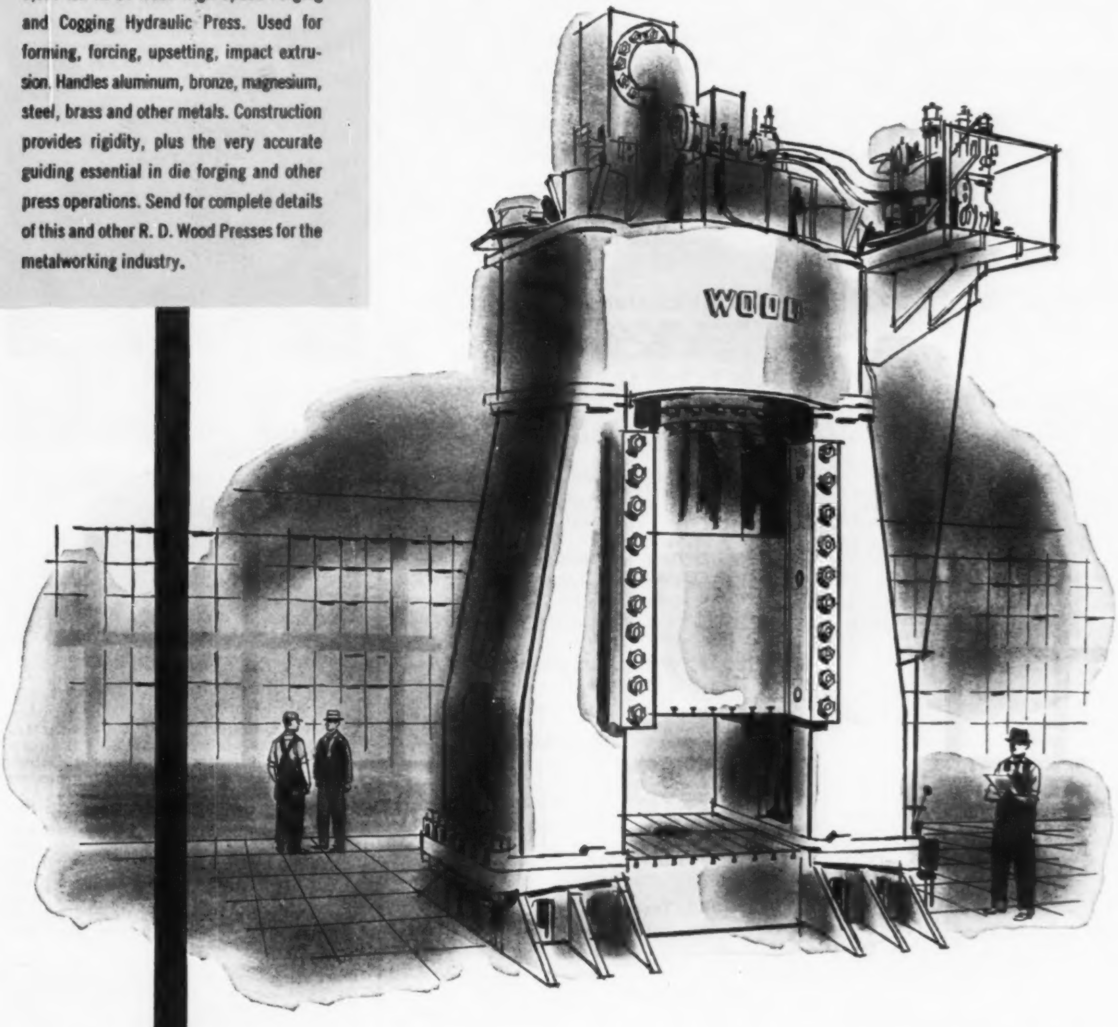
Fafnir Bearing Co., New Britain, Conn.



3,000-ton R. D. Wood High Speed Forging and Cogging Hydraulic Press. Used for forming, forcing, upsetting, impact extrusion. Handles aluminum, bronze, magnesium, steel, brass and other metals. Construction provides rigidity, plus the very accurate guiding essential in die forging and other press operations. Send for complete details of this and other R. D. Wood Presses for the metalworking industry.

The most productive plants use R. D. Wood Presses

For proof, look at production records—and downtime for maintenance. Then watch an R. D. Wood Press at work. See for yourself the smooth, precise operation—the dependable performance—even under tough conditions. Finally, inspect an R. D. Wood Press up close. Notice the soundness of design, the excellence of materials, the scrupulous care given to each detail of construction. These are the reasons why R. D. Wood Presses have been the standard of excellence throughout the metalworking industry.



R. D. WOOD COMPANY

PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA

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BEARINGS, Ball

Ball & Roller Bearing Co., Danbury, Conn.
Boston Gear Works, 3200 Main St., North Quincy, Mass.
Fafnir Bearing Co., New Britain, Conn.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
New Departure Div., Bristol, Conn.
Nice Ball Bearing Co., 30th & Hunting Park Ave., Philadelphia, Pa.
Norma-Hoffman Bearings Corp., Stamford, Conn.

BEARINGS, Bronze and Special Alloy

Boston Gear Works, 3200 Main St., North Quincy, Mass.
Bunting Brass & Bronze Co., Spencer and Carlton Aves., Toledo, Ohio.
Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio.
Haynes Stellite Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York, N. Y.

BEARINGS, Needle

Orange Roller Bearing Co., Inc., Orange, N. J.

BEARINGS, Oilless

Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio.
Ryerson, Jos. T., & Son, 2558 W. 16th St., Chicago 18, Ill.

BEARINGS, Roller

Ball & Roller Bearing Co., Danbury, Conn.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Norma-Hoffman Bearings Corp., Stamford, Conn.
Orange Roller Bearing Co., Inc., Orange, N. J.
Rollway Bearings Co., Inc., 541 Seymour St., Syracuse, N. Y.
Timken Roller Bearing Co., Canton, Ohio.

BEARINGS, Thrust

Ball & Roller Bearing Co., Danbury, Conn.
Bunting Brass & Bronze Co., Spencer and Carlton Aves., Toledo, Ohio.
Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio.
Fafnir Bearing Co., New Britain, Conn.
General Electric Co., Schenectady, N. Y.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., Nicetown, Philadelphia, Pa.
Norma-Hoffman Bearings Corp., Stamford, Conn.
Orange Roller Bearing Co., Inc., Orange, N. J.
Rollway Bearing Co., Inc., Syracuse, N. Y.
Timken Roller Bearing Co., Canton, Ohio.

BELT SANDERS—See Grinding Machines, Abrasive Belt

BENCH CENTERS

Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BENCHES AND STOOLS

South Bend Lathe Works, South Bend 22, Ind.

BENDERS, Bar, Tube, Channel, etc.

Bath, Cyril Co., 32324 Aurora Road, Solon, Ohio.
Greenlee Bros. & Co., 2136—12th St., Rockford, Ill.
Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, Ill.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

BENDERS, Cleat

Smith, R. E., Waukegan, Ill.

BENDERS, Plate, Etc.

Bath, Cyril Co., 32324 Aurora Road, Solon, Ohio.
Cincinnati Shaper Co., Hopple & Gerrard, Cincinnati, Ohio.
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, Ill.

BENDING MACHINES, Hydraulic

Baldwin-Lima-Hamilton Corp., Eddystone Div., Philadelphia 42, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Chambersburg Engrg. Co., Chambersburg, Pa.
Hannifin Corp., 501 Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio.
Lake Erie Engrg. Corp., Kenmore Sta., Buffalo, N. Y.
Niagara Machine & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, Ill.
Watson-Stillman Co., Roselle, N. J.

BENDING MACHINES, Pipe

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, Ill.
Watson-Stillman Co., Roselle, N. J.

BENDING ROLLS

Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland, Ohio.
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, Ill.

BLAST CLEANING EQUIPMENT

Modern Ind. Engrg. Co., 14230 Birwood Ave., Detroit 38, Mich.
Pangborn Corp., Hagerstown, Md.

BLOWERS

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

BLUING LAYOUT

Dykem Co., 2307 N. 11th St., St. Louis 6, Mo.

BLUEPRINT MACHINERY & ACCESSORIES

Wickes Brothers, 512 No. Water St., Saginaw, Mich.

BOLTS, NUTS AND SCREWS

Allen Mfg. Co., 133 Sheldon St., Hartford 2, Conn.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Ottemiller, W. H., & Co., York, Pa.
Parker-Kalon Div., Clifton, N. J.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Standard Pressed Steel Co., Jenkintown, Pa.
Williams & Co., J. H., 400 Vulcan St., Buffalo 7, N. Y.

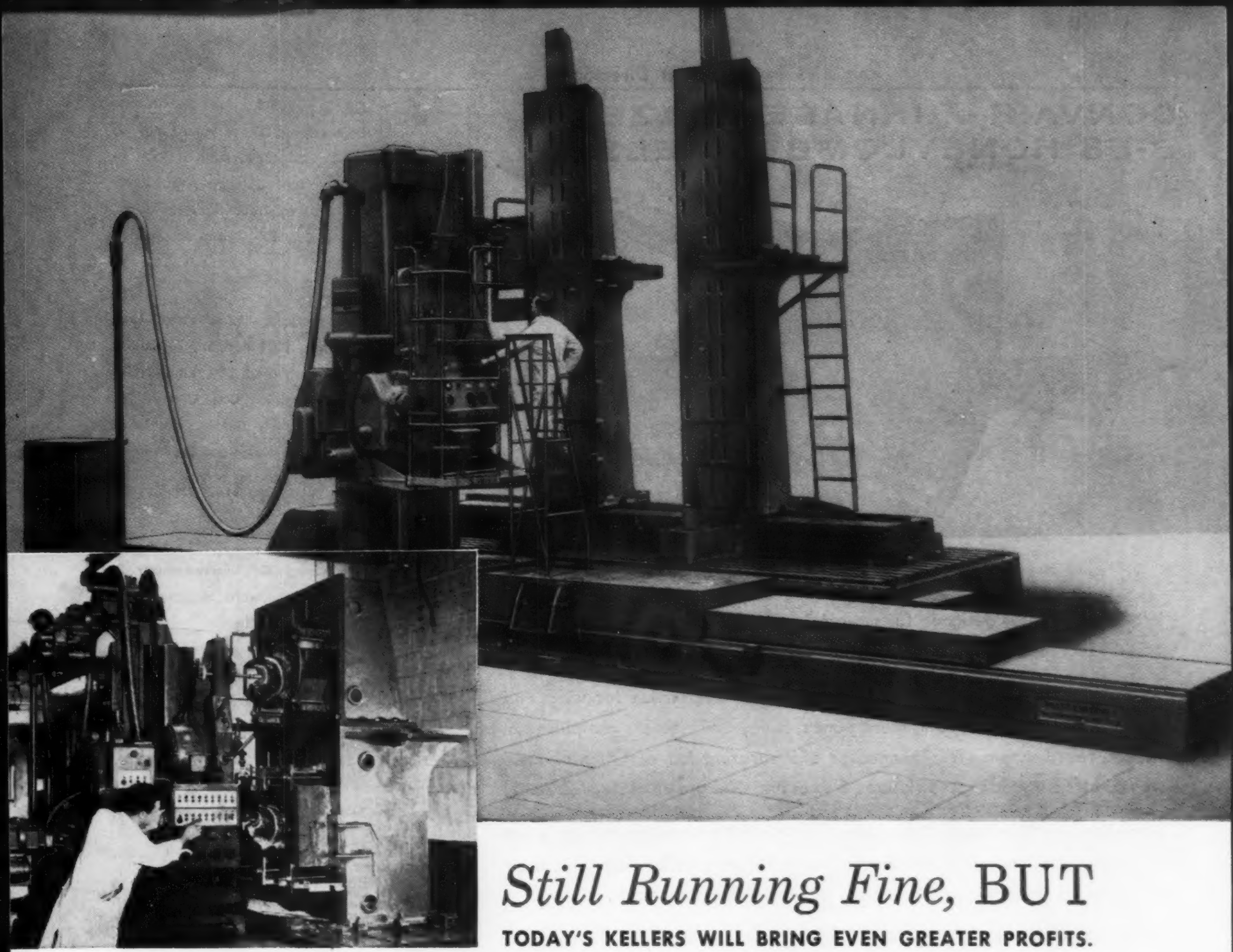
BOOKS, Technical

Industrial Press, 93 Worth St., New York 13, N. Y.

BORING BARS

Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Ingersoll Milling Machine Co., 2442 Douglas St., Rockford, Ill.
Lovejoy Tool Co., Inc., Springfield, Vt.
Metallurgical Products Dept. of General Electric Co., Box 237 Roosevelt Park Annex, Detroit 32, Mich.

(Continued on page 304)



Still Running Fine, BUT

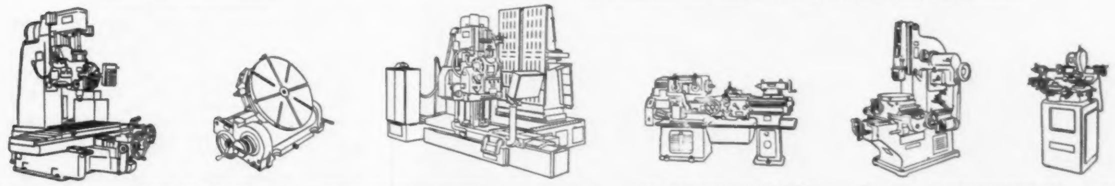
TODAY'S KELLERS WILL BRING EVEN GREATER PROFITS.

You may put off replacing an older machine because "it's still paying its way." But is it? A machine tool purchased years ago may be the cause of lost efficiency, higher labor and per-unit costs, the inability to produce high quality *economically.* Failure to compete profitably with more modern machines may be putting you far behind your competitors. For example, just 10 short years ago our Keller BG-2 Tracer-Controlled Miller was the ultimate in productive efficiency, but let's check the added features possessed by its successor, the new P&W BG-22 Keller . . .

1. Operates from any conventional polyphase current, with no motor generator set required.
2. Increased travel speed of cutting tool . . . to an infinitely variable range from 0.5 to 30.0 inches per minute.
3. Three dimensional tracer permits motion in 2 directions at the same time, yet allows interlocking action for accuracy. One slide is kept always in motion, while the second moves as required to follow the shape and maintain accurate interlocking action.
4. More nearly perfect surface cutting speed over irregular contours assured through superimposed auto-speed control of all motions.
5. Increased capacities . . . up to 20 feet horizontal x 7 feet vertical.
6. Centralized operator controls supplemented by remote control stations.
7. Rapid traverse in all three motions.
8. Automatic lubrication.
9. Score-proof phenolic bearing surfaces on all slides and lead screw nuts.

Write for complete information.

Pratt & Whitney Company, Incorporated
12 Charter Oak Boulevard, West Hartford, Conn.



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Universal Engineering Co., Frankenmuth 2, Mich.
Van Norman Mch. Co., 3640 Main St., Springfield 7, Mass.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

BORING HEADS

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio.
Bridgeport Machines, Inc., 500 Lindley St., Bridgeport 6, Conn.
Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Lovejoy Tool Co., Inc., Springfield, Vt.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

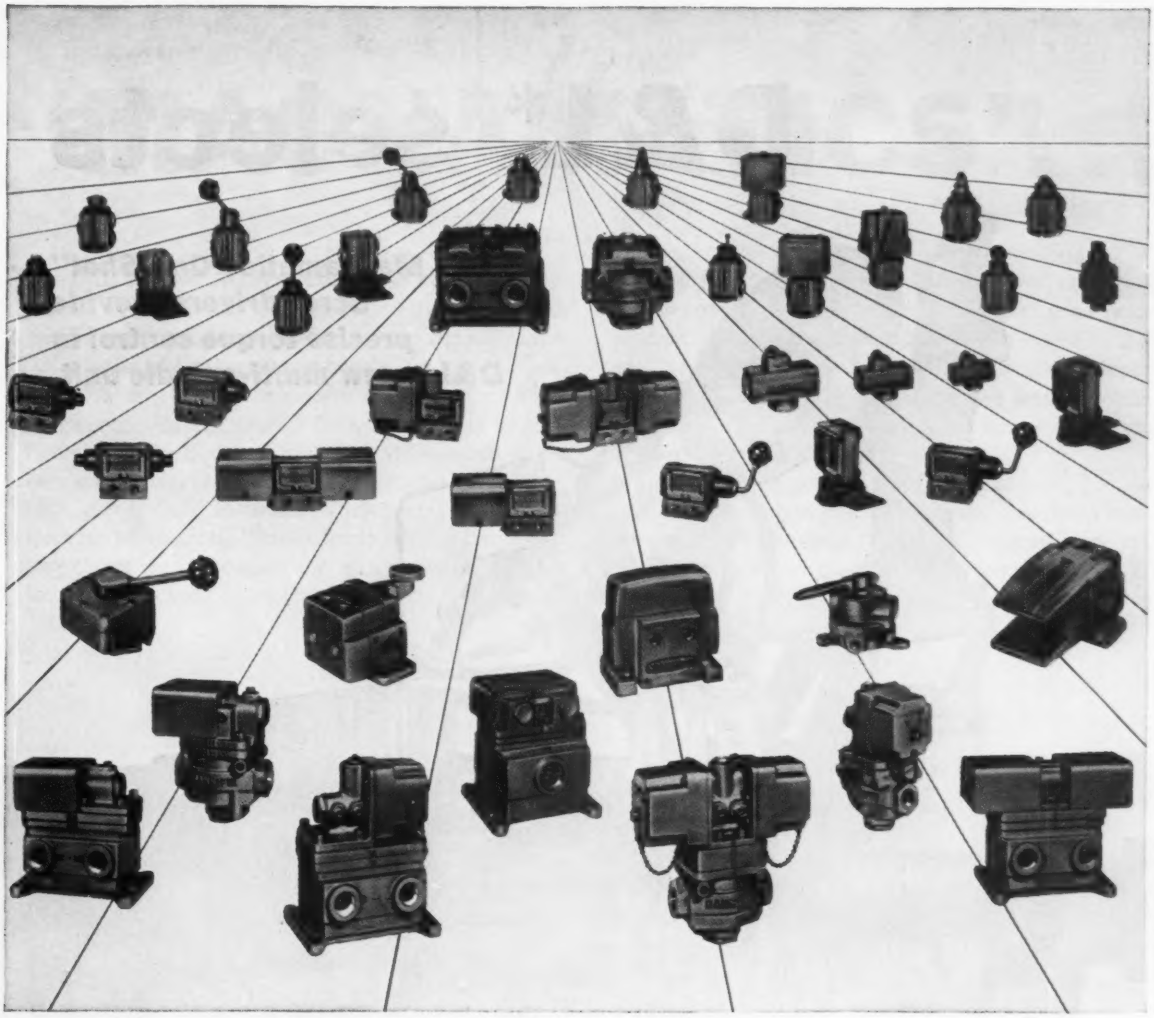
BORING MACHINES

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio.
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio.
Bullard Co., Bridgeport 6, Conn.
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis & Thompson Co., 4460 N. 24th St., Milwaukee 10, Wis.
DeVlieg Machine Co., Ferndale, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray Co., G. A., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukana, Wis.
Kearney & Trecker Corp., Milwaukee, Wis.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., Lansing, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pope Machinery Co., Haverhill, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Snyder Tool & Engrg. Co., 3400 E. Lafayette St., Detroit 9, Mich.
Wadell Equipment Co., Clark, N. J.
Wales-Strippit Co., Akron, N. Y.

BORING MILLS, Horizontal

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Lucas Mch. Tool Div., New Britain Mch. Co., 12302 Kirby Ave., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Portage Machine Co., 1025 Sweitzer Ave., Akron 11, Ohio.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.

(Continued on page 308)



These valves like tough jobs

Discriminating engineers are finding that out. More and more of them are specifying Hannifin valves for every kind of directional air control—including the really tough jobs.

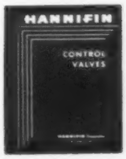
There are plenty of reasons why: Inspired simplicity of design. Fewer parts—and *those* easily and quickly replaceable. Ability to serve a wide range of applications with fewer valve models. And—above all—fast, smooth operation.

Your Hannifin man will gladly give you the whole story. We'll tell you where to get in touch with him—after you examine the big Hannifin catalog.

AIR CONTROL

HANNIFIN

VALVES



For this complete catalog **showing all the Hannifin directional air control valves, write to Hannifin Corporation, 509 South Wolf Road, Des Plaines, Illinois.**

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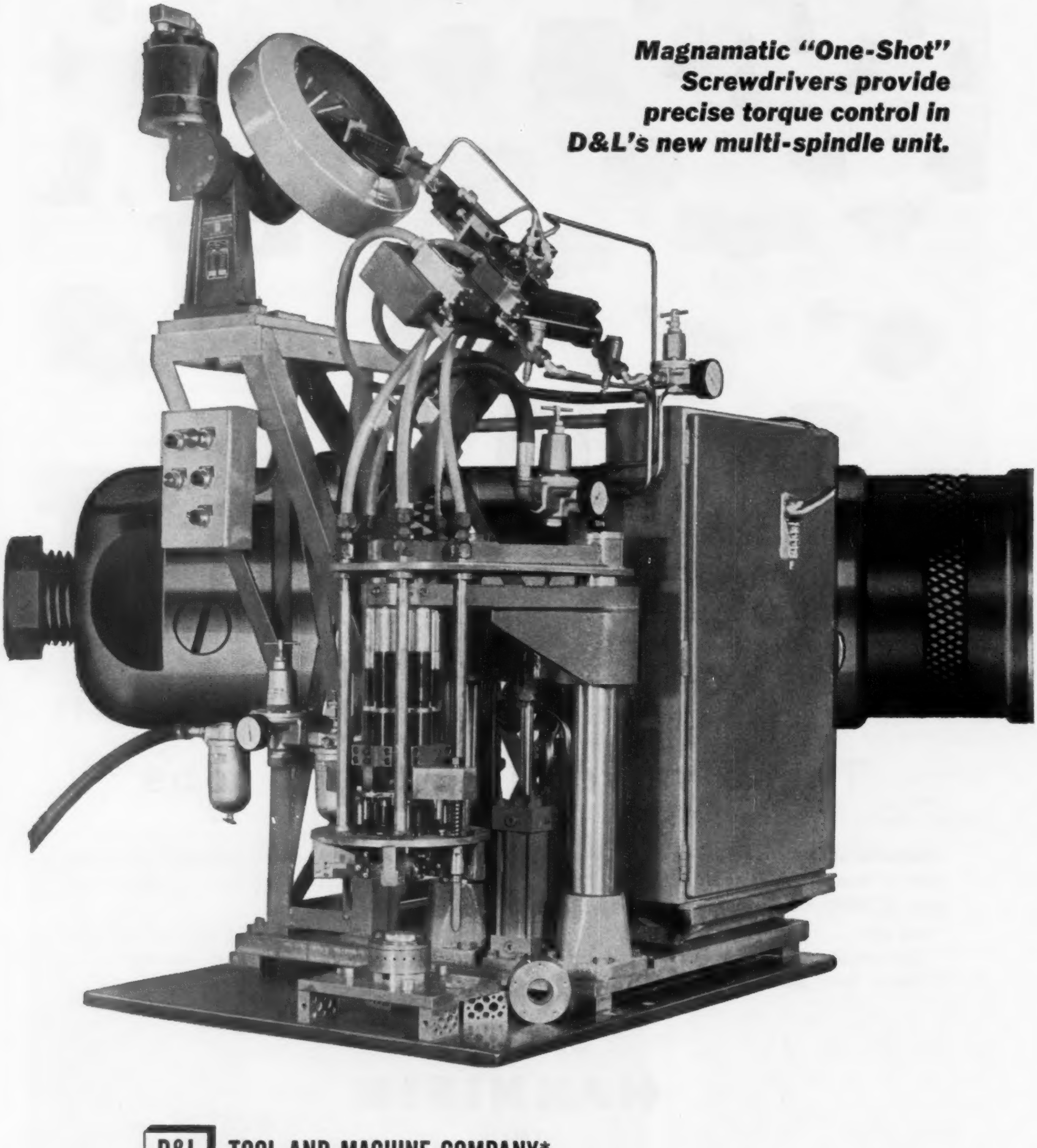
D&L* selects

Magnamatic "One-Shot" Screwdrivers provide precise torque control in D&L's new multi-spindle unit.

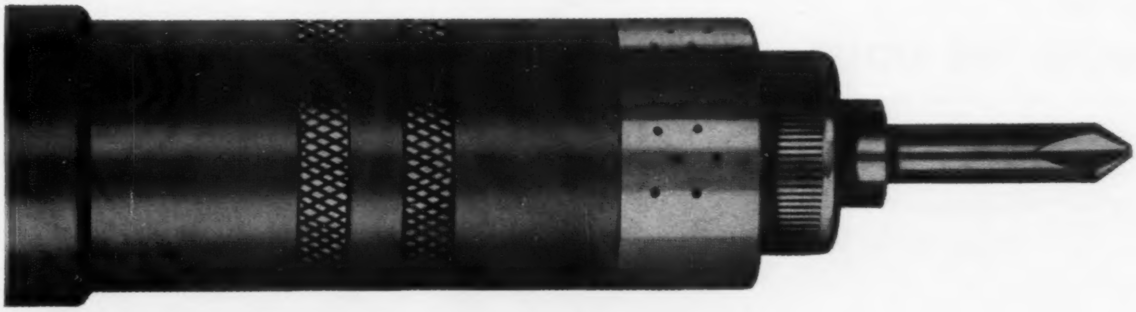


"MAGNAMATICS"...

The D&L Tool and Machine Company's newest development is a fully automatic multiple screwdriver that feeds and drives five screws simultaneously *to desired torque* . . . at a rate of 3500 screws an hour!

D&L's development engineers specified "One-Shot" Magnamatic drivers. Studies from hundreds of difficult fastening assignments proved that Magnamatic is the only screwdriver clutch that fully meets the demands of high speed, fully automatic screwdriving equipment. Because Magnamatic "thinks for itself", its torque-setting clutch jaws disengage the instant desired fastener torque is reached . . . there's no clutch ratcheting or impacting to cause jaw wear . . . the absence of ratcheting means consistent torque settings that don't need readjustment; the absence of impacting means longer bit life, and no possibility of burred screw heads, stripped threads, or sheared fasteners . . . air line pressure variations don't affect delivered torque . . . torque output can be changed to suit job requirements.

Investigate the possibilities of Magnamatic. Let our Field Engineers show you how the wear-free clutch components of Magnamatic "One-Shot" screwdrivers and nutrunners will insure accuracy and consistency in all automatic multiple units.



Complete line of motors and clutches available for constructing multi-spindle screwdriving and nutrunning arrangements. Capacities #2 screws to bolts requiring 120 pounds of torque.

Portable multi-spindle units featuring Magnamatic "One-Shot" nutrunners and screwdrivers are also available.

Chicago Pneumatic

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_____Please send me full information about multi-spindle units featuring "Magnamatic" screwdrivers.

_____Please send me FREE booklet SP-3165 "Magnamatic Case Histories"

_____Have representative call.

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Company_____________________________

Address_____________________________

City_______________Zone_____State_______

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BORING MILLS, Vertical

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Coso Corp., 405 Lexington Ave., New York 17, N. Y.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
New Britain Mch. Co., New Britain, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Portage Mch. Co., 1025 Sweitzer Ave., Akron 11, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Triplex Machine Tool Corp., 75 West St., New York 6, N. Y.

BORING TOOLS

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Apex Tool & Cutter Co., Inc., 285 Canal St., Shelton, Conn.
Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Crucible Steel Co. of America, Henry W. Oliver Bldg., Mellon Sq., Pittsburgh 22, Pa.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park, Annex Detroit 32, Mich.
Portage Machine Co., 1025 Sweitzer Ave., Akron 11, Ohio.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

BRAKES, Press and Bending

Bath, Cyril Co., 32324 Aurora Road, Solon, Ohio.
Cincinnati Shaper Co., Hopple & Gerrard, Cincinnati, Ohio
Cleveland Crane & Engrg. Co., Wickliffe, Ohio.
Dreis & Krump Mfg. Co., 7400 Loomis Blvd., Chicago 36, Ill.
Ferracute Machine Co., Bridgeport, N. J.
Lodge & Shipley Co., Hamilton 1, Ohio.
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Smith, R. E., Waukegan, Ill.
Verson Allsteel Press Co., 93rd St. and S. Kenwood Ave., Chicago, Ill.
Watson-Stillman Co., Roselle, N. J.

BRASS

American Brass Co., 25 Broadway, New York, N. Y.
Bridgeport Brass Co., Bridgeport, Conn.
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y.

BROACHES

American Broach & Mch. Co., Ann Arbor, Mich.
Colonial Broach & Machine Co., P. O. Box 37, Harper Sta., Detroit 13, Mich.
Detroit Broach Co., Inc., 950 S. Rochester Rd., Rochester, Mich.
duMont Corp., Greenfield, Mass.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Lapointe Mch. Tl. Co., Tower St., Hudson, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237 Roosevelt Park Annex, Detroit 32, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

BROACHING MACHINE, Internal

American Broach & Mch. Co., Ann Arbor, Mich.
Colonial Broach & Machine Co., P. O. Box 37, Harper Sta., Detroit 13, Mich.
Detroit Broach Co., Rochester, Mich.
Lapointe Mch. Tl. Co., Tower St., Hudson, Mass.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

BROACHING MACHINE, Surface

American Broach & Mch. Co., Ann Arbor, Mich.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati, Ohio.
Colonial Broach & Machine Co., P. O. Box 37, Harper Sta., Detroit 13, Mich.
Detroit Broach Co., Rochester, Mich.
Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8, Ohio.
Lapointe Mch. Tl. Co., Tower St., Hudson, Mass.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BRONZE

American Brass Co., Waterbury 20, Conn.
Bridgeport Brass Co., Bridgeport, Conn.
Mueller Brass Co., Port Huron 35, Mich.

BRUSHES, Industrial, Tampico, Wire Wheel, Etc.

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, Ohio.

Synchronous Speed with Induction Simplicity

New *Synduction* Motor

...has uses in:

- Synthetic Fiber Production
- Wire Drawing
- Plate-Glass Conveyors
- Packaging Machinery
- Food Processing
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- Metering Pumps
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- Printing Presses
- Frequency Converter Sets
- Drives for Electronic Power Supplies
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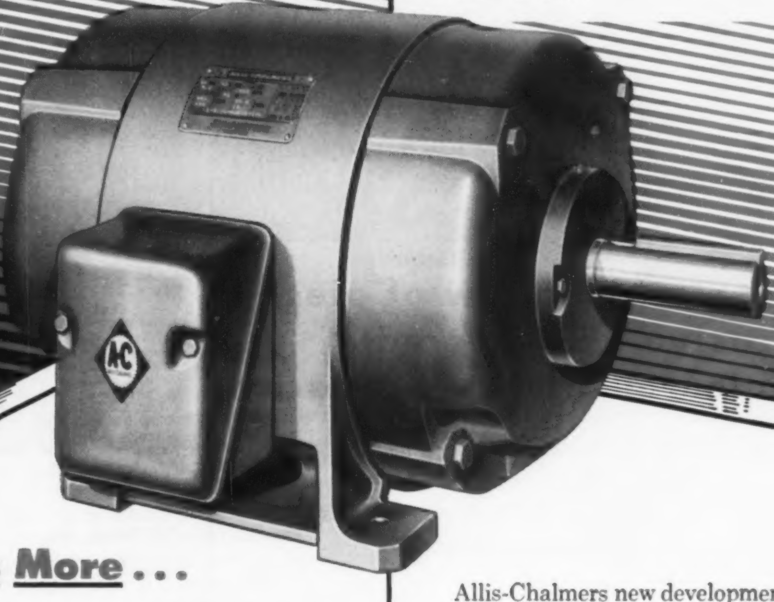
Do YOU Have an Application?

Allis-Chalmers engineers are anxious to help you determine where *Synduction* motors can improve your operations. Call your A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin, for Bulletin 51B8440.



Here's More . . .

- **Constant speed, regardless of load or voltage, depends only on frequency**
- **Synchronized speeds for a number of motors**
- **Adjustable speed by frequency control at any speed setting**

Allis-Chalmers new development—the *Synduction* motor — now makes these characteristics available at low cost. The sturdy frame and simple design, similar to that of a squirrel-cage motor, eliminates collector rings, brushes and rotor insulation — cuts maintenance. Other important advantages include across-the-line starting, wide range of speeds and high efficiency.

Synduction is an Allis-Chalmers trademark.

ALLIS-CHALMERS

A-5118

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CABINETS, Tool
Standard Pressed Steel Co., Jenkintown, Pa.

CALIPERS, Spring, Firm-Joint, Transfer, Hermaphrodite, etc.—See Layout and Drafting Tools, Machinists' Small Tools

CALIPERS, Vernier
Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S. Co., Athol, Mass.

CAM CUTTING MACHINES
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Van Norman Mch. Co., 3640 Main St., Springfield 7, Mass.

CAM MILLING AND GRINDING MACHINES
American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Landis Tool Co., Waynesboro, Pa.
Rowbottom Machine Co., Waterbury, Conn.

CAMS
Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 S. 13th, Newark 3, N. J.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Rowbottom Machine Co., Waterbury, Conn.

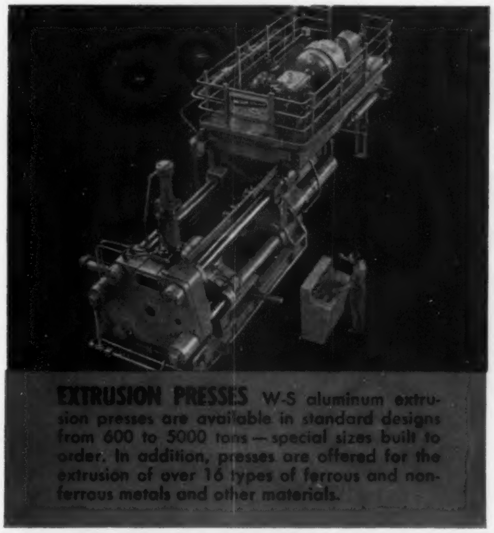
CARBIDES
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Chicago-Latrobe Twist Drill Wks., 411 W. Ontario St., Chicago 10, Ill.
DoAll Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Pa.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd. Ferndale, Mich.

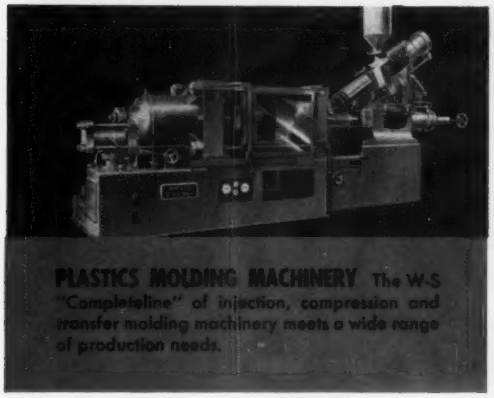
CASTINGS, Die
American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

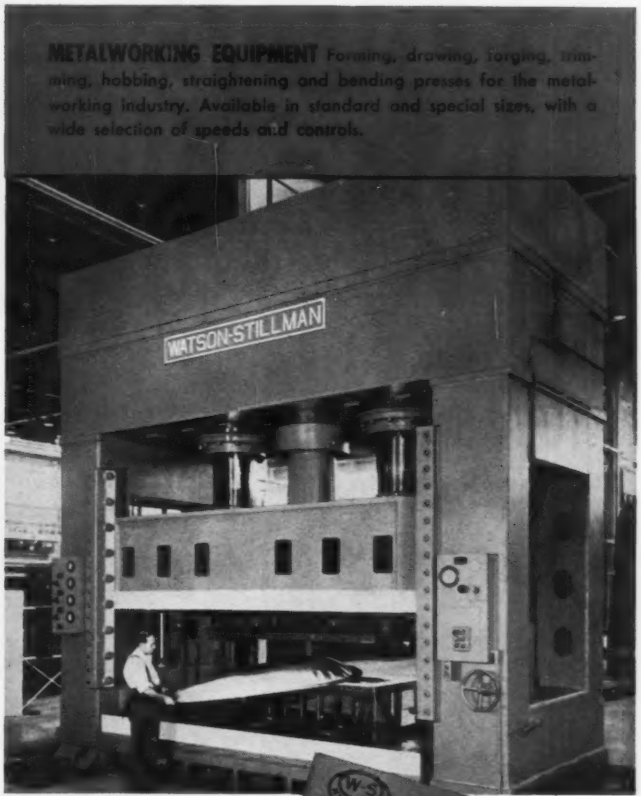
CASTINGS, Non-ferrous
American Crucible Products Co., Lorain, Ohio.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Centrifugally Cast Products Div.—Shenango Furnace Co., Denver, Ohio.
Dow Chemical Co., Midland, Mich.
Mueller Brass Co., Port Huron 35, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.

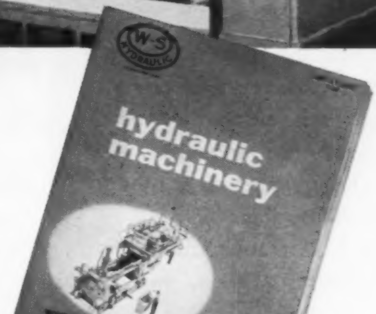
CASTINGS, Gray Iron, Malleable
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Centrifugally Cast Products Div.—Shenango Furnace Co., Dover, Ohio.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

Would you like to consult an expert on hydraulic equipment?









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CASTINGS, Steel, Stainless, etc.

Allegheny Ludlum Steel Corp., Pittsburgh, Pa
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Crucible Steel Co. of America, Henry W. Oliver Bldg., Pittsburgh 22, Pa.

CEMENT, Abrasive Disc

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Walls Sales Corp., 333 Nassau Ave., Brooklyn 22, N. Y.

CENTER-DRILLING MACHINES

Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CENTER PUNCHES — See Machinists' Small Tools

CENTERS, Grinding Machines, Indexing Head and Lathe

Houston Grinding & Mfg. Co., Inc., Houston 8, Texas
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit, Mich.
Scully Jones & Co., 1906 Rockwell St., Chicago 8, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

CERAMIC TOOL MATERIAL—See Tool Material, Ceramic

CHAINS, Power Transmission and Conveyor

Boston Gear Works, 14 Hayward St., Quincy 71, Mass.

CHUCKING MACHINES, Multiple-Spindle Automatic

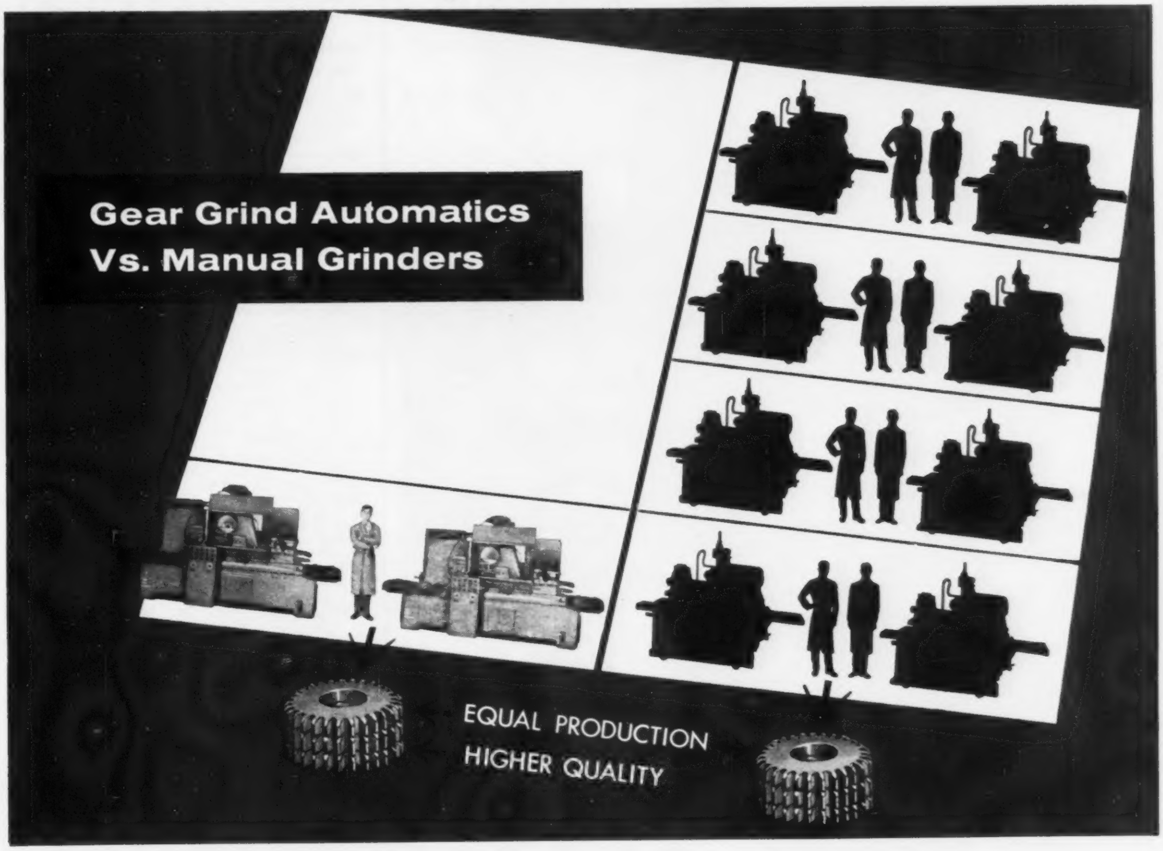
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Cone Automatic Mch. Co., Inc., Windsor, Vt.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Goss & DeLeeuw Mch. Co., Kensington, Conn.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., 2729 Lyons Ave., Lansing, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.
Wickes Brothers, 512 No. Water St., Saginaw, Mich.

CHUCKING MACHINES, Single-Spindle Automatic

Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Potter and Johnston Co., 1027 Newport Ave., Pawtucket, R. I.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

(*Continued on page 314*)

Here's real grinding economy!



2 Automatics with 1 Operator Equals 8 Manuals with 8 Skilled Operators

¼ the floor space
¼ the number of machines
⅛ the manpower

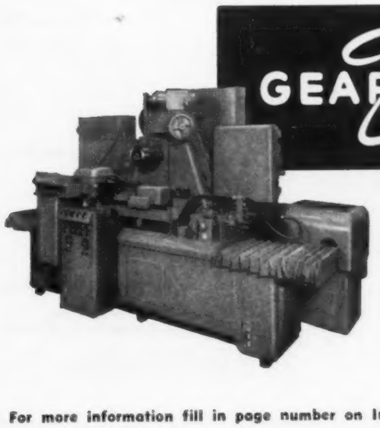
Gear Grinding Economy

PUMP ROTORS
600 pcs./8 hrs./machine

PUMP GEAR

floor to floor grinding cycle—6 minutes for 7 tooth; 12 minutes for 11 tooth

GEARGRIND Detroit



For all the facts—write today!

THE GEAR GRINDING MACHINE COMPANY

3921 Christopher, Detroit 11, Michigan

Contract Grinding Service

COMPLETE RANGE OF GEAR & SPLINE GRINDERS
EXTERNAL INTERNAL

Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 83, Ohio.

CHUCKS, Air Operated

Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Calif.
Cushman Chuck Co., Windsor Ave., Hartford 2, Conn.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Collet

Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Cushman Chuck Co., 800 Windsor St., Hartford 2. Conn.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Errington Mech. Lab. Inc., 24 Norwood Ave., Staten Island 4, N. Y.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Combination Universal-Independent

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Horton Chuck, Windsor Locks, Conn.
Kearney & Trecker Corp., Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Compensating

Burg Tool Mfg. Co. Inc., Gardena, Calif.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Diaphragm

Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Wadell Equip. Co., Terminal Ave., Clark, N. J.

CHUCKS, Drill, Key Type

Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Drill, Keyless

Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Jacobs Mfg. Co., West Hartford, Conn.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.

(Continued on page 316)

For more information fill in page number on Inquiry Card, on page 259

CHUCKS, Full Floating

Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Gisholt Mch. Co., Madison 10, Wis.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Gear

Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Horton Chuck, Windsor Locks, Conn.
Le Maire Tool & Mfg. Co., Dearborn, Mich.

CHUCKS, Independent

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Homestrand, Inc., Larchmont, N. Y.
Horton Chuck, Windsor Locks, Conn.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Lathes, etc.

Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Cal.
Bullard Co., Brewster St., Bridgeport 2, Conn.
Cushman Chuck Co., Windsor Ave., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Horton Chuck, Windsor Locks, Conn.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Standard Tool Co., 3950 Chester Ave., Cleveland, Ohio.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Magnetic

Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Hanchett Magna-Lock Corp., Big Rapids, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Walker, O. S., Inc., Worcester, Mass.

CHUCKS, Power Operated

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Quick Change and Safety

Burg Tool Mfg. Co. Inc., Gardena, Calif.
Jacobs Mfg. Co., West Hartford 10, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Ring Wheel

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

CHUCKS, Tapping

DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Jacobs Mfg. Co., West Hartford, Conn.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Universal Three-Jaw

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Gisholt Mch. Co., Madison 10, Wis.
Homestrand, Inc., Larchmont, N. Y.
Horton Chuck, Windsor Locks, Conn.
Kearney & Trecker Corp., Milwaukee 14, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Wrenchless

Gisholt Mch. Co., Madison 10, Wis.

CIRCUIT-BREAKERS

General Electric Co., Schenectady 5, N. Y.

CLAMPS, "C", Toggle, Toolmakers' Parallel—See Set-Up Equipment Spacing Equipment

CLEANERS, Metal

Oakite Products, Inc., 19 Rector St., New York, N. Y.

CLUTCHES

Cleveland Punch & Shear Works, Co., 3917 St. Clair Ave., Cleveland 14, Ohio.
Dynamatic Div. Eaton Mfg. Co., Kenosha, Wis.
Fawick Corp., Cleveland, Ohio
Minster Mch. Co., Minster, Ohio.
Rockford Clutch Div., Rockford, Ill.

COLLETS—See Chucks, Collet

COMBINATION SQUARES—See Machinists' Small Tools

COMPARATORS, Dial, Electronic and Air

DoAll Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn. (dial, thread)
Sheffield Corp., Box 893, Dayton 1, Ohio.
Starrett, L. S., Co., Athol, Mass.

COMPARATORS, Optical

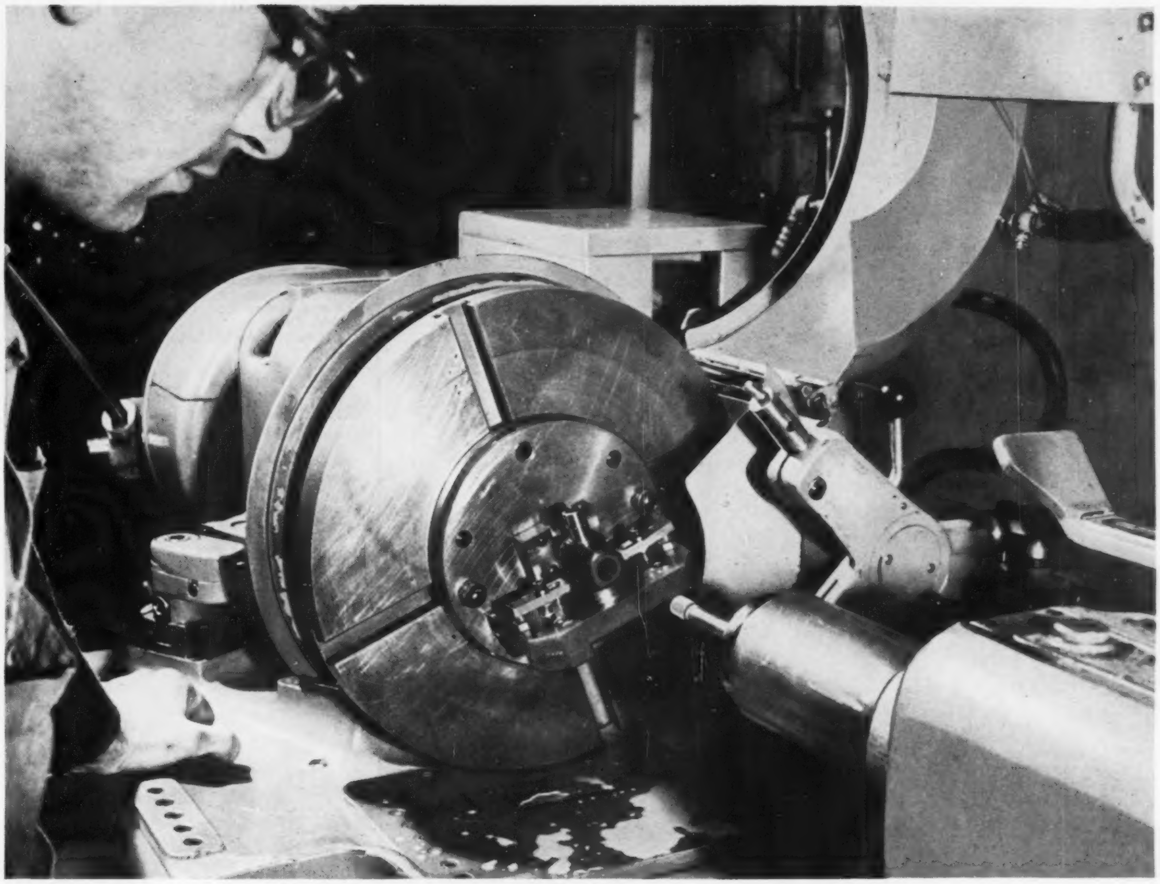
Bausch & Lomb Optical Co., Rochester, N. Y.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Eastman Kodak Co., Rochester, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

COMPOUNDS, Cleaning—See Cleaners, Metal

COMPOUNDS, Cutting, Grinding, Metal Drawing, etc.—See Cutting and Grinding Fluids

COMPRESSORS, Air

Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.



"Everything they claimed and then some..."

That's Mr. Gerald H. Buchholz talking. He's owner and manager of the Federal Tool and Instrument Company, Corona, New York, and he's talking about his No. 1116 Bryant Internal Grinder.

For more than two years now, Federal has been turning out close-tolerance work with a Bryant Grinder. Mr. Buchholz leaves no doubt as to its value: "It saves us both time and labor, and it holds tolerances better than any similar machine.

"Before our purchase of the 1116 we used an attachment on another machine for our fine work. But it was too slow for our production. We got the Bryant with an eye toward new business — and we got it!

"This machine has been everything the Bryant people claimed and then some. A man can ask no more than that."

See for yourself how a Bryant Internal Grinder can do better grinding *faster*. Ask for an immediate demonstration!

BRYANT Chucking Grinder Co.

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Offices: Indianapolis • Cleveland • Chicago • Detroit • Mt. Vernon, N. Y. • Philadelphia

Internal Grinders • Internal & External Thread Gages • Granite Surface Plates • Magnetic Drums for Computers • Special Machinery

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CONTOUR FOLLOWER—See Tracing Attachments

CONTRACT WORK

Baker Brothers, Inc, 1000 Post St., Toledo 10, Ohio.
Bliss, E. C., Co., 1375 Raff Rd., S. D., Canton, Ohio.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio.
Eisler Engrg. Co., 750 S. 13th St., Newark 3, N. J.
Hartford Special Machinery Co., 287 Homestead St., Hartford, Conn.
Kearney & Trecker Corp., Milwaukee 14, Wis.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Van Keuren Co., Watertown, Mass.

CONTROLLERS

Allen-Bradley Co., 1331 S. 1st St., Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.

CONTROL SHAFTS—See Lead-screws & Splines, Ball Bearing

CONVEYORS FOR DUST, CHIPS, ETC.

Barnes, W. F. & John Co., Rockford, Ill.
Indiana Commercial Filters Corp., 28 South Ave., Lebanon, Ind.

COPPER

American Brass Co., 25 Broadway, New York, N. Y.
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

COUNTERBORES AND COUNTERSINKS

Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago, Ill.
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 120 Oakman Blvd., Detroit 32, Mich.
Haynes Stellite Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York
Heller Tool Co., Newcomerstown, Ohio
National Twist Drill & Tool Co., Rochester, Mich.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mass.

COUNTERS

Starrett, The L. S., Co., Athol, Mass.

COUPLINGS

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
Mueller Brass Co., Port Huron, Mich.
Philadelphia Gear Works, Erie Ave., and G Sts., Philadelphia, Pa.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Standard Pressed Steel Co., Jenkintown, Pa. (Shaft)
Thor Power Tool Co., 175 N. State St., Aurora, Ill.
Walker Co., Inc., O. S., Rockdale St., Worcester, Mass.

For more information fill in page number on Inquiry Card, on page 259

CRANES, Electric Traveling
Cleveland Crane & Engrg. Co., Wickliffe, Ohio

CUTTERS, Keyseating
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Davis Keyseater Co., 405 Exchange St., Rochester 8, N. Y.
DoAll Co., Des Plaines, Ill.
du Mont Corp., Greenfield, Mass.
Mitts & Merrill, 1009 So. Water St., Saginaw, Mich.
National Twist Drill Co., Rochester, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CUTTERS, Milling
Apex Tool & Cutter Co., Inc., 235 Canal St., Shelton, Conn.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Goddard & Goddard Co., Detroit, Mich.
Gorton, George, Mch. Co., 1321 Racine St., Racine, Wis.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn. (dial, thread)
Haynes Stellite Co., Kokomo, Ind.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Kennametal, Inc., Latrobe, Pa.
Lovejoy Tool Co., Inc., Springfield, Vt.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Twist Drill & Tl. Co., Rochester, Mich.
Onsrud Machine Works, Inc., Niles, Ill.
Tomkins-Johnson Co., Jackson, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CUTTING AND GRINDING FLUIDS
Cincinnati Milling Products Div., Cincinnati, Ohio
Cincinnati Milling and Girnding Mchs., Inc., Cincinnati 9, Ohio
Cities Service Oil Co., 70 Pine St., New York, N. Y.
DoAll Co., Des Plaines, Ill.
Oakite Products, Inc., 26 Rector St., New York 6, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 600 Fifth Ave., New York, N. Y.
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia, Pa.
Texas Co., 135 E. 42nd St., New York, N. Y.

CUTTING-OFF MACHINES, Lathe Type
Bardons & Oliver, Inc., 1133 West Ninth St., Cleveland 13, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Cone Automatic Mch. Co., Windsor, Vt.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Modern Machine Tool Co., Jackson, Mich.

CUTTING-OFF SAWS, Abrasive Wheel
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Pa.
Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, Ill.

CUTTING TOOLS—See Tool Material

CYLINDERS, Air
Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.
Hannifin Corp., 501 Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.
Tomkins-Johnson Co., Jackson, Mich.

CYLINDERS, Hydraulic
Barnes, John S., Corp., 301 S. Water St. Rockford, Ill.
Chicago Pneumatic Tool Co., New York 17, N. Y.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio
Logansport Machine Co., Inc., Logansport, Ind.
Oilgear Co., 1569 W. Pierce St., Milwaukee Wis.
Vickers, Inc., Detroit 32, Mich.
Wilson, K. R., Inc., Arcade. N. Y.

DEBURRING MACHINES
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Modern Industrial Eng. Co., 14230 Birwood Ave., Detroit 38, Mich.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio
Sheffield Corp., Box 893, Dayton 1, Ohio
Wallace Supplies Mfg. Co., 1308 Diversey Parkway, Chicago 14, Ill.

DEMAGNETIZERS
Blanchard Mch. Co., 64 State St., Cambridge Mass.
Lufkin Rule Co., Saginaw, Mich.

DIE CASTINGS—See Casting, Die

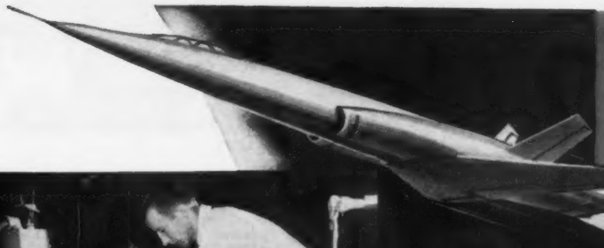
DIE CASTING MACHINES
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

DIE CUSHIONS
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Mch. Corp., 6499 W. 65th St., Chicago, Ill.
Danly Mch. Specialties, Inc., 2100 S. Laramie, Chicago 50, Ill.
Dayton Rogers Mfg. Co., Minneapolis, Minn.
Federal Machine & Welder Co., Overland Ave., Warren, Ohio
Minster Mch. Co., Minster, Ohio
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.

DIEING MACHINES
Pratt & Whitney Co., Inc., West Hartford, Conn.

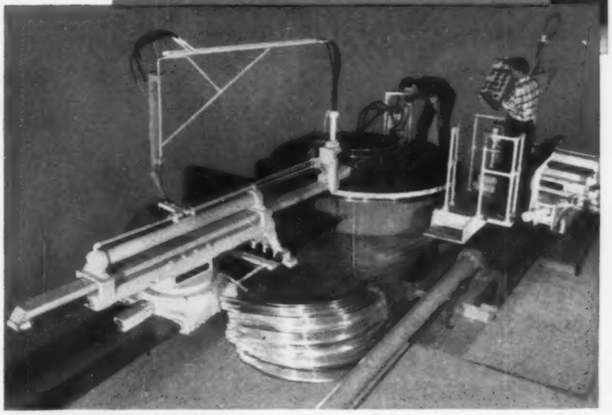
DIE INSERTS, Carbide
Allegheny Ludlum Steel Corp., Pittsburgh, Pa
Kennametal Inc., Latrobe, Pa.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.

DIE SETS AND DIEMAKERS' SUPPLIES
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Danly Mch. Specialties, Inc., 2100 S. Laramie, Chicago 50, Ill.
Producto Mch. Co., 985 Housatonic Ave., Bridgeport 1, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.
Wales-Strippit Co., Akron, N. Y.

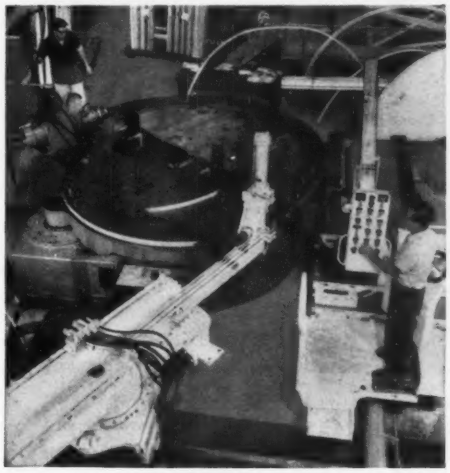


Producibility GOES Up WITH BATH RADIAL DRAW FORMERS

AT NORTH AMERICAN, Columbus, Model CF 25 Bath Radial Draw Former produces a variety of changing angle curves for the F-100D Super Sabre.



AT SIKORSKY DIVISION, United Aircraft, this 12-½ Ton Bath Radial Draw Former produces accurate curved parts for military and commercial series helicopters.

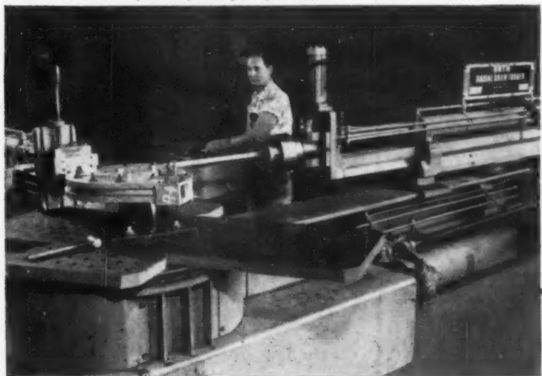


AT RYAN, Bath CF 25-35 turns out fuselage sections for jet tanker and jet transports as well as an accelerated output of jet engine parts.

In forming the difficult curves and tough metals for modern high speed designs . . . in aircraft, jet and missile production . . . where producibility really counts, more and more parts are being formed on Bath Radial Draw Formers.

The combined stretch and compression methods of Bath Radial Draw Forming yield accurate cross section and contour in curved parts. Radial Draw Forming offers one piece construction in complicated parts, accuracy in the formed piece that eliminates subsequent machining operations and bends up to a full 360° of curvature.

Ask for our new Catalog CF 856 describing Bath Radial Draw Formers or Catalog 32310 describing the parts forming facilities of our Contract Forming Division.



AT NORTH AMERICAN, Los Angeles, one of a battery of Bath Radial Draw Formers which are producing airframe and missile components.

THE CYRIL BATH COMPANY

32324 AURORA ROAD • SOLON, OHIO
(LOCATED IN THE GREATER CLEVELAND AREA)
Manufacturers of Radial Draw Formers • Dies • Tools
Press Brakes • Tangent Bending Sequence Presses • Press Type Brakes • Special Machines

DIE SINKING MACHINES—See Milling Machines, Die Sinking, etc.

DIE STOCKS—See Stocks and Dies

DIES, Blanking, Forming, Drawing, Extruding, etc.

Bath, Cyril Co., 32324 Aurora Road, Solon, Ohio
Cincinnati Shaper Co., Hopple & Garrard, Cincinnati, Ohio
Dreis & Krump Mfg. Co., 7400 Loomis Blvd., Chicago 36, Ill.
Ferracute Mch. Co., Bridgeton, N. J.
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Olofsson Corp., Lansing, Mich.
Ryerson & Son, Inc., Jos. T., 16th & Rockwell Sts., Chicago 8, Ill.
Vascoloy-Ramet Corp., Waukegan, Ill.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.
Wales-Strippit Corp., North Tonawanda, N. Y.

DIES, Lettering and Embossing

Wales-Strippit Corp., North Tonawanda, N. Y.

DIES, Self-opening Threading

Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Eastern Mch. Screw Corp., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio

DIES, Thread Cutting—See Stocks and Dies

DIES, Thread Rolling

Landis Machine Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.

DISINTEGRATORS

Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Electro-Spark Co., Inc., 23 E. 26th St., New York 10, N. Y.
Elox Corp., Royal Oak 3, Mich.

DIVIDERS AND TRAMMELS—See Layout and Drafting Tools

DIVIDING HEADS—See Indexing and Spacing Equipment

DOWEL PINS

Allen Mfg. Co., 133 Sheldon St., Hartford 2, Conn.
Danly Mch. Specialties, Inc., 2100 S. Laramie, Chicago 50, Ill.
DoAll Co., Des Plaines, Ill.
Producto Machine Co., 985 Housatonic Ave., Bridgeport, Conn.
Standard Pressed Steel Co., Jenkintown, Pa.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.

DRAWING COMPOUNDS

Oakite Products, Inc., 26 Rector St., New York 6
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.

DRESSERS, Grinding Wheel

Colonial Broach & Machine Co., P. O. Box 37, Harper St., Detroit 13, Mich.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Hoglund Eng. & Mfg. Co., Inc., Berkeley Hts., N. J.
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 724 Union Ave., Bridgeport, Conn.
Norton Co., 1 New Bond St., Worcester, Mass.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

DRIFT KEYS

Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago, Ill.
DoAll Co., Des Plaines, Ill.
Scully-Jones & Co., 1906 S. Rockwell St., Chicago 8, Ill.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

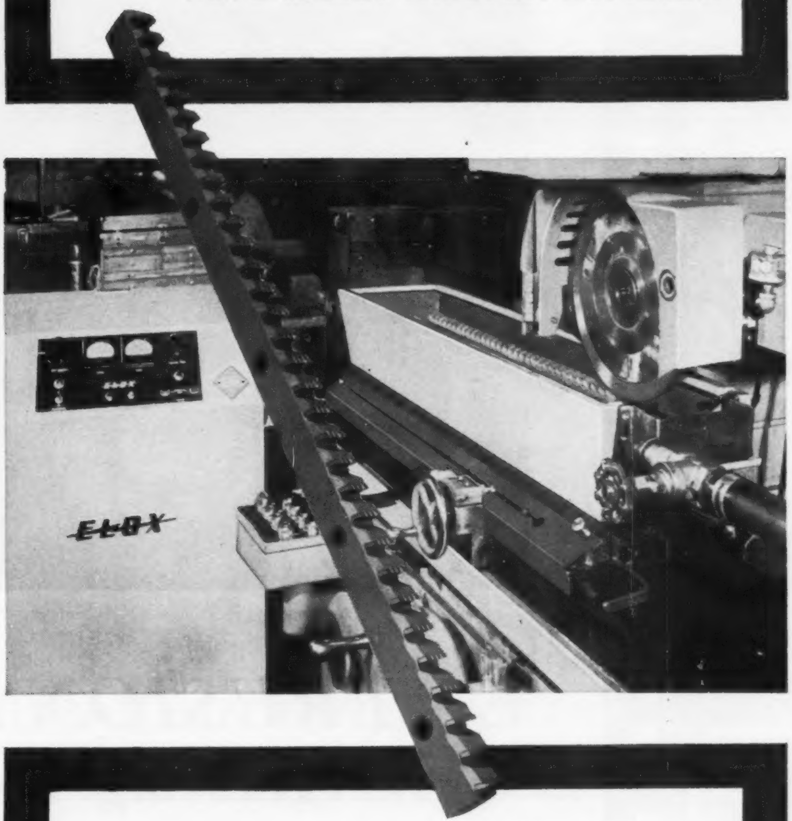
DRILL HEADS, Multiple Spindle

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Avey Drilling Machine Co., 25 East Third St., Covington, Ky.
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Baush Machine Tool Co., 15 Watson Ave., Springfield, Mass.
Buffalo Forge Co., Broadway, Buffalo, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.

(Continued on page 326)

"elox saves us $294 ... 8 operations form grinding this broach"

Ford Motor Aircraft Division



The Job...
Broach, used for broaching the pine tree form on turbine blades of the J-57 Jet engine.

Savings on preformed carbide blanks......	$ 32.00
Omitted operations savings....	120.00
Diamond wheel savings.......	142.00
Sums up to................	$294.00

NO DIAMOND WHEEL...

EDM substitutes inexpensive brass wheels costing less than $45 for expensive diamond wheels costing a minimum of $150. Brass wheels are formed for $1 as against a diamond wheel contour forming cost of $35.

NO PREFORMED CARBIDE BLANKS...

Conventional machining necessitates preformed tungsten carbide and preformed steel shanks. EDM machines the carbide, brazing material and steel simultaneously, and requires no indexing to assure a perfectly formed broach as to location and size.

OPERATIONS...

Conventionally machined, the pine tree broach requires 22 operations. EDM does it better in 14.

Electrical Discharge Machining has reduced the machining time of this intricate form in 32 carbide tipped teeth to a total time cycle of 33 minutes . . . one-half the time of abrasive grinding. Tolerances held to: +0, —.0002".

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*T.M. Reg.

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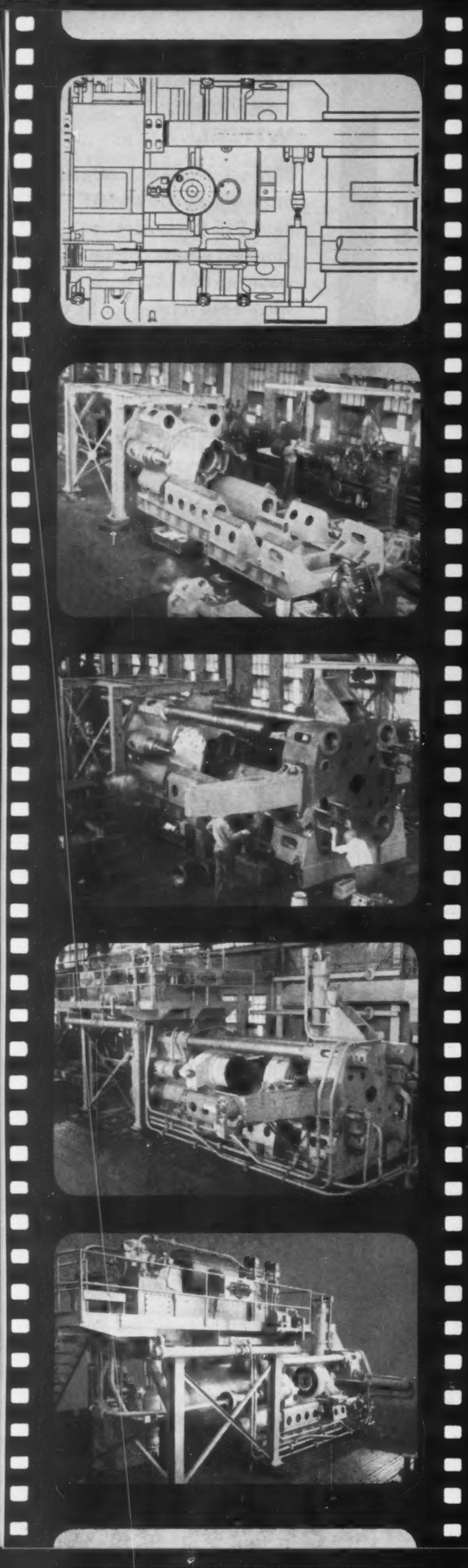

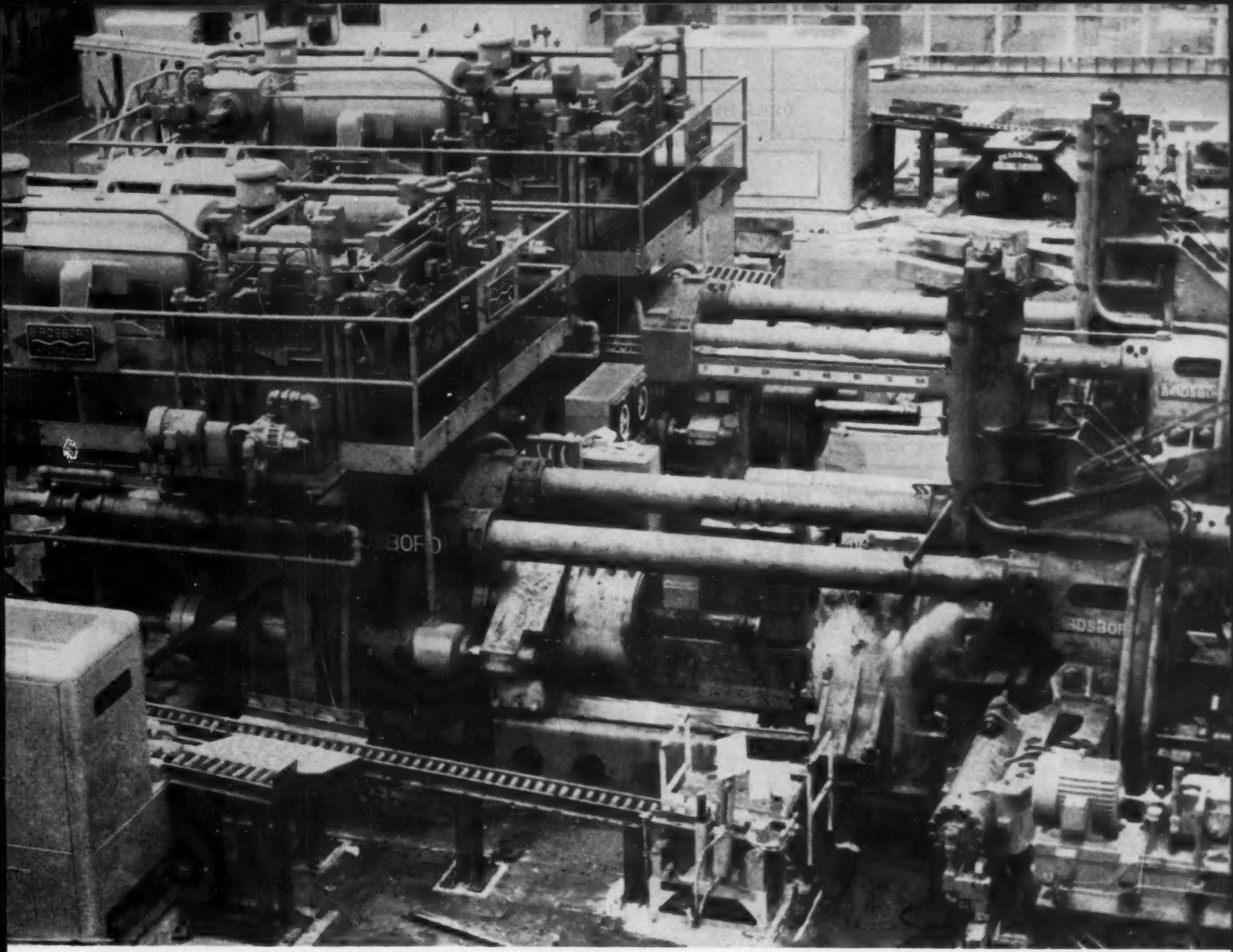

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Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., Milwaukee 14, Wis.
Leland Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Richmond, Ind.
Snyder Tool & Engrg. Co., 3400 Lafayette, Detroit 7, Mich.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.
United States Drill Head Co., 616 Burns, Cincinnati, Ohio

DRILL HEADS, Unit Type

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Kingsbury Mch. Tool Corp., Keene, N. H.
Millholland, W. K. Machinery Co., 6403 Westfield Blvd., Indianapolis 5, Ind.
Rehnberg-Jacobson Mfg. Co., 2135 Kiswaukee St., Rockford, Ill.
Snow Manufacturing Co., Bellwood, Illinois

DRILL SLEEVES AND EXTENSION HOLDERS

Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Automatic Tool Co., Richmond, Ind.
National Twist & Tool Co., Rochester, Mich.
Scully-Jones & Co., 1906 S. Rockwell St., Chicago 8, Ill.

DRILLING AND BORING UNITS, Self-contained

Avey Drilling Machine Co., 25 East Third St., Covington, Ky.
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Watson Ave., Springfield, Mass.
Buhr Machine Tool Co., 839 Green St., Ann Arbor, Mich.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Homestrand, Inc., Larchmont, N. Y.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Kearney & Trecker Corp., Milwaukee 14, Wis.
LaSalle Tool, Inc., 3840 E. Outer Dr., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
Morris Machine Tool Co., Inc., 933 Harriet St., Cincinnati 3, Ohio
National Automatic Tool Co., S. 7th and N. Sts., Richmond, Ind.
Russell Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit, Mich.
Townsend, H. P. Mfg. Co., Elmwood, Conn.
Western Machine Tool Works, Holland, Mich.

DRILLING MACHINES, Automatic

Avey Drilling Machine Co., 25 East Third St., Covington, Ky.
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Watson Ave., Springfield, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Edlund Mchry. Co. Div., Cortland, N. Y.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., Milwaukee 14, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
LaSalle Tool, Inc., 3840 E. Outer Dr., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Modern Industrial Eng. Co., 14230 Birwood Ave., Detroit 38, Mich.
Moline Tool Co., Moline, Ill.
Morris Machine Tool Co., Inc., 933 Harriet St., Cincinnati 3, Ohio
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
Olofsson Corp., Lansing, Mich.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Snow Manufacturing Co., Bellwood, Ill.
Townsend, H. P., Mfg. Co., Elmwood, Conn.
Wales-Strippit Corp., Akron, N. Y.

DRILLING MACHINES, Bench

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Avey Drilling Machine Co. 2,5 East Third St., Covington, Ky.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.

(Continued on page 329)


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Delta Power Tool Div., 400 N. Lexington Ave., Pittsbugh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Henry & Wright Div., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester, Mass.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.

DRILLING MACHINES, Deep Hole

Avey Drilling Machine Co., 25 East Third St., Covington, Ky.
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
Morris Machine Tool Co., Inc., 933 Harriet St., Cincinnati 3, Ohio
National Automatic Tool Co., Inc., S. 7th and N. St., Richmond, Ind.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Wales-Strippit Corp., Akron, N. Y.

DRILLING MACHINES, Gang, Multiple-spindle

Avey Drilling Machine Co., 25 East Third St., Covington, Ky.
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Watson Ave., Springfield, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cleereman Machine Tool Co., Green Bay, Wis.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 4460 124th St., Milwaukee 10, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Henry & Wright Div., Hartford, Conn.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Leland-Gifford Co., Box 989, Worcester, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Modern Industrial Eng. Co., 14230 Birwood Ave., Detroit 38, Mich.
Moline Tool Co., Moline, Ill.
Morris Machine Tool Co., Inc., 933 Harriet St., Cincinnati 3, Ohio
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
South Bend Lathe Works, South Bend 22, Ind.
Western Machine Tool Works, Holland, Mich

DRILLING MACHINES, Radial

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
American Tool Works Co., Pearl and Eggleston Ave., Cincinnati, Ohio
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Carlton Mch. Tool Co., 2961 Meeker St., Cincinnati 25, Ohio
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio
Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Morris Machine Tool Co., Inc., 933 Harriet St., Cincinnati 3, Ohio
Onsrud Machine Works, Inc., Niles, Ill.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Western Machine Tool Works, Holland, Mich.

DRILLING MACHINES, Sensitive

Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Avey Drilling Machine Co., 25 East Third St., Covington, Ky.
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burg Tool Mfg. Co., Inc., Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Edlund Machinery Co. Div., Cortland, N. Y.
Foote-Burt Co., 1300 St. Clair Ave., Cleveland 8, Ohio
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Henry & Wright Div., Hartford, Conn.
Leland-Gifford Co., Box 989, Worcester, Mass.
Levin & Son, Inc., Louis, 3610 So. Broadway, Los Angeles, Calif.
National Automatic Tool Co., Inc., S. 7th and N. St., Richmond, Ind.
Snow Manufacturing Co., Bellwood, Illinois
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Townsend, H. P., Mfg. Co., Elmwood, Conn.
Wales-Strippit Corp., Akron, N. Y.
Western Machine Tool Works, Holland, Mich

DRILLING MACHINES, Universal Radial

Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.

DRILLING MACHINES, Upright

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Avey Drilling Machine Co., 25 East Third St., Covington, Ky.
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Barnes, W. F. & John Co., Rockford, Ill.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio
Cincinnati Lathe & Tool Co., Marburg Ave., Cincinnati 9, Ohio
Cleereman Machine Tool Co., Green Bay, Wis.
Cosa Corp., 405 Lexington Ave., New York, 17, N. Y.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.

(Continued on page 330)

Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
National Automatic Tool Co., Inc., S. 7th and N. St., Richmond, Ind.
Rehnberg-Jacobson Mfg. Co., 2135 Kishwaukee St., Rockford, Ill.
Snow Manufacturing Co., Bellwood, Ill.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Wales-Strippit Corp., Akron, N. Y.
Western Machine Tool Works, Holland, Mich.

DRILLS, Center

Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago, Ill.
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

DRILLS, Core

Ace Drill Corp., Adrian, Mich.
Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Twist Drill & Tl. Co., Rochester, Mich.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

DRILLS, Deep Hole, Gun

Ace Drill Corp., Adrian, Mich.
Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago 10, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tl. Co., Rochester, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

DRILLS, Oil Hole, Oil Tube

Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tl. Co., Rochester, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

DRILLS, Portable Electric

Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Thor Power Tool Co., Aurora, Ill.

DRILLS, Portable Pneumatic

Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Onsrud Machine Works, Inc., Niles, Ill.
Thor Power Tool Co., Aurora, Ill.

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DRILLS, Rachet

Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

DRILLS, Subland

Ace Drill Corp. Adrian, Mich.
Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Whitman & Barnes, 40600 Plymouth Rd. Plymouth, Mich.

DRILLS, Twist, High-Speed Steel, Carbon Steel

Ace Drill Corp., Adrian, Mich.
Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Thor Power Tool Co., 175 N. State St., Aurora, Ill.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

DRILLS, Twist, Carbide, Carbide-tipped

Ace Drill Corp., Adrian, Mich.
Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.
Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoAll Co., Des Plaines, Ill.
Heller Tool Co., Newcomerstown, Pa.
National Twist Drill & Tool Co., Rochester, Mich.
Thor Power Tool Co., 175 N. State St., Aurora, Ill.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

DRILLS, Wire

Ace Drill Corp., Adrian, Michigan
Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

DUPLICATING ATTACHMENTS — See Tracing Attachments

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Pangborn Corp., Hagerstown, Md.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 14, Ohio

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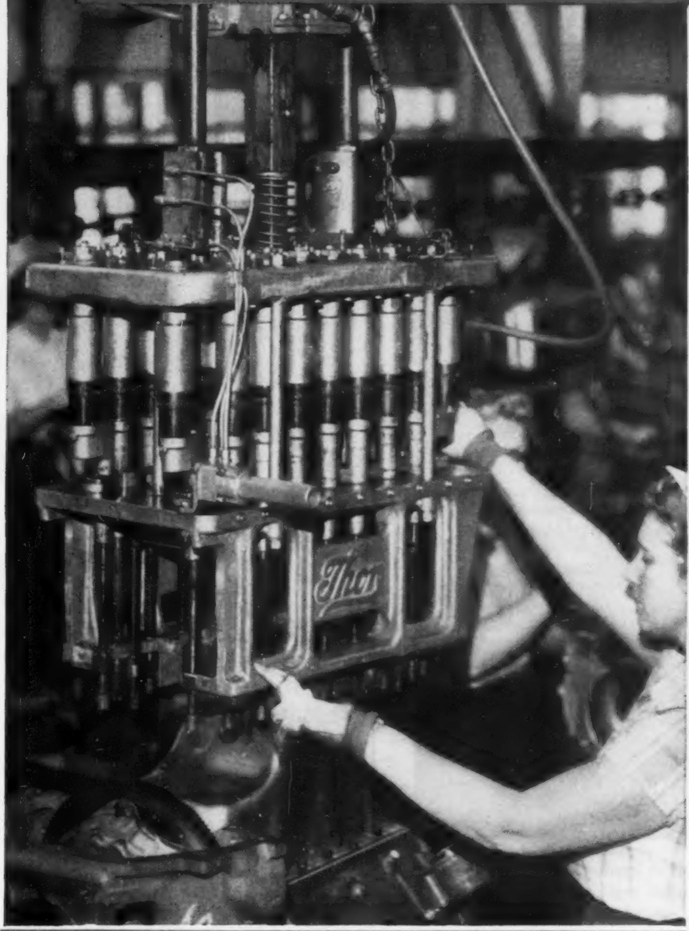

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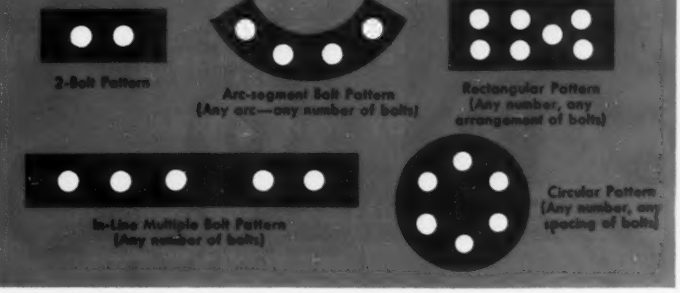

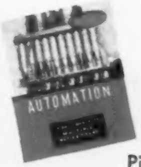

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ELECTRICAL DISCHARGE MACHINES
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ELECTROPLATING EQUIPMENT
Wagner Brothers, Inc., 433 Midland Ave., Detroit 3, Mich.

ENGRAVING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton, Geo., Mach., 1321 Racine St., Racine Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

EXPANDERS, Mechanical, Hydraulic
Grotnes Machine Wks., Inc., 5454 N. Walcott, Chicago 40, Illinois

EXTRACTORS, Screw
Chicago-Latrobe Twist Drill Wks., 411 W. Ontario St., Chicago 10, Ill.

Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.
Walton Co., Hartford 10, Conn.
Williams & Co., J. H., 400 Vulcan St., Buffalo 7, N. Y.

FACING HEADS
Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Davis Boring Tool Div. Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Mummert-Dixon Co., Hanover, Pa.

FANS, Exhaust, Ventilating
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

FEEDERS, Automatic
Perry Equipment & Eng. Co., Erie, Penna.
Production Feeder Corp., Mentor, Ohio
V & O Press Co., Hudson, New York

FILES, Band
DoALL Co., Des Plaines, Ill.

FILES, General-purpose, Swiss Pattern
DoALL Co., Des Plaines, Ill.
Heller Tool Co., Newcomerstown, Ohio
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.

FILES AND BURRS, Rotary
DoALL Co., Des Plaines, Ill.
Heller Tool Co., Newcomerstown, Ohio
Pratt & Whitney Co., Inc., West Hartford, Conn.
Severance Tool Ind., Inc., Saginaw, Mich.
Simonds Saw & Steel Co., Fitchburg, Mass.
Wesson Co., 1220 Woodward Heights Blvd. Ferndale, Mich.

FILING MACHINES
Chicago Pneumatic Tool Co., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

FILTERS, Coolant and Oil
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Commercial Filters Corp., Lebanon, Ind.
Industrial Filtration Co., 15 Industrial Ave., Lebanon, Ind.
Marvel Engineering Co., 7227 N. Hamlin Ave., Chicago 45, Ill.

FINISHES, Machine and Metal
Lowe Bros. Co., Dayton, Ohio

FLAME-HARDENING MACHINES
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Gleason Works, 1000 University Ave., Rochester 3, N. Y.

FORGING HAMMERS, Steam and Air
Chambersburg Engrg. Co., Chambersburg, Pa.

FORGING MACHINES, Headers, Upsetters, Presses
Ajax Mfg. Co., Euclid, Cleveland 17, Ohio
Bliss, E. W. Co., 1375 Raff Rd. S. W., Canton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
National Machinery Co., Tiffin, Ohio

FORGINGS, Drop
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Crucible Steel Co. of America, Henry W. Oliver Bldg., Mellon Square, Pittsburgh 22, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Hollow-Bored
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron, Mich.

FORGINGS, Press
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Minster Mch. Co., Minster, Ohio
Mueller Brass Co., Port Huron, Mich.

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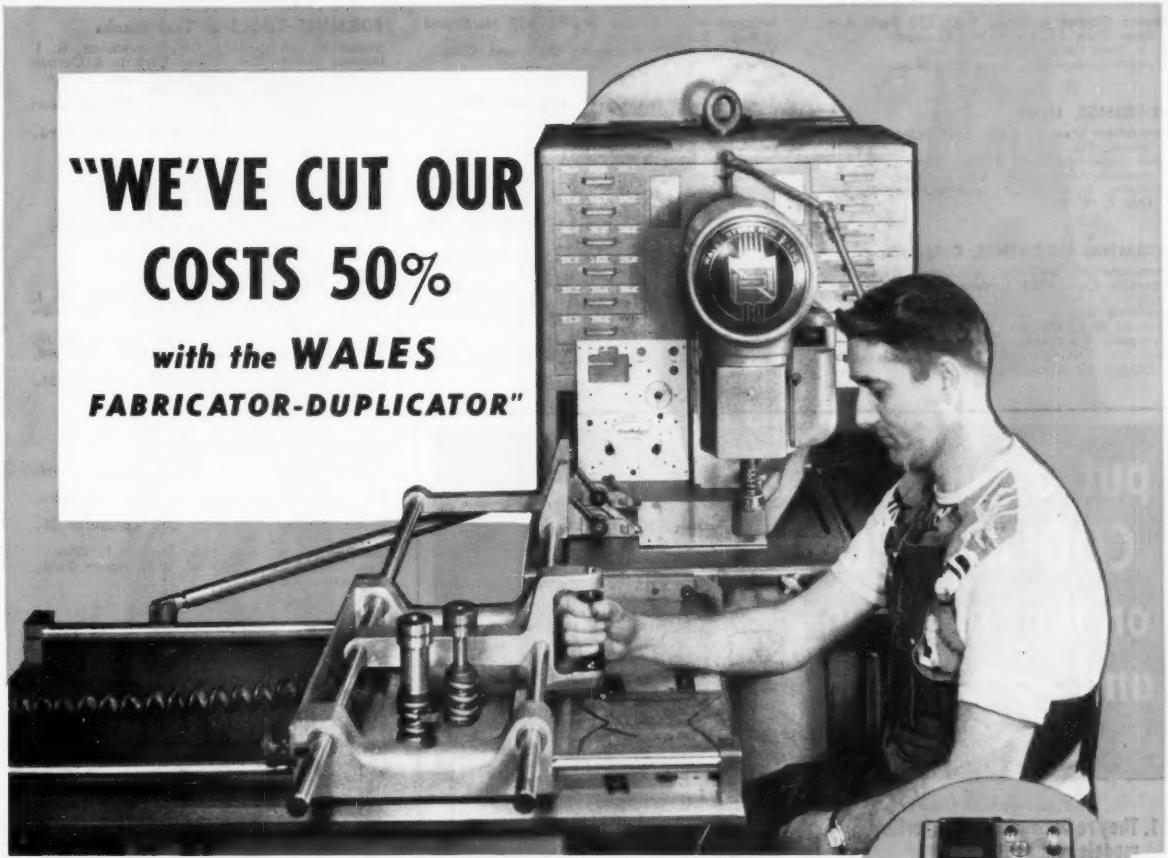

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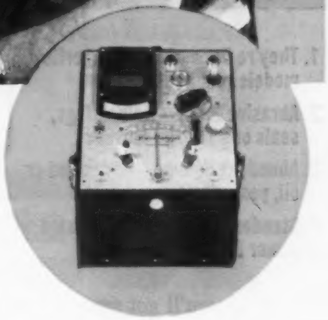

The Breathalyzer is an instrument for determining immediately the degree of alcoholic intoxication. This instrument is used widely by law enforcement agencies and Laboratories.

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WALES MOBILE FIELD UNITS

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For more information fill in page number on Inquiry Card, on page 259

Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y. (die-pressed)
U. S. Steel Corp., Pittsburgh, Pa.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Upset

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
New Departure Div., Bristol, Conn.
Vanadium-Alloys Steel Co., Latrobe, Pa.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

FORMING MACHINES, Cold-rolling

Ferracute Machine Co., Bridgeton, N. J.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Niagara Mch. & Tool Works, 637 Northland Ave., Buffalo, N. Y.
Yoder Co., 5500 Walworth, Cleveland, Ohio

FORMING MACHINES, Multiple-slide

Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Baldwin-Lima-Hamilton Corp., Lima-Hamilton Div., Hamilton, Ohio
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Chambersburg Engrg. Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65 St., Chicago 38, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Dreis & Krump Mfg. Co., 7416 Loomis Blvd., Chicago 36, Ill.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North Main St., Ampere, N. J.

FORMING TOOLS or Tool Blanks

Brown & Sharpe Mfg. Co., Providence, R. I.
Haynes Stellite Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York
Kennametal, Inc., Latrobe, Pa.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

FURNITURE, Shop

Standard Pressed Steel Co., Jenkintown, Pa.

GAGE BLOCKS

Brown & Sharpe Mfg. Co., Providence, R. I.
Dearborn Gage Co., 22038 Beech St., Dearborn, Mich.
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES, Air Comparator

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.

GAGES, Automatic Sorting

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.

GAGES, DIAL, Bore, Height, Depth, Thread, Groove, etc.

Ames, B. C., Co., Waltham 54, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Comtor Co., 47 Farwell St., Waltham 54, Mass.
Dearborn Gage Co., 22038 Beech St., Dearborn, Mich.
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Lufkin Rule Co., Saginaw, Mich.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.
Starrett, The L. S., Co., Athol, Mass.

GAGES, Electric Comparator

Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
General Electric Co., Schenectady, N. Y.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio
Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.

GAGES, Grinding

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.

GAGES, Machinists' Hand, including Center, Cutter Clearance, Drill Point, Drill Size, Planer, Radius, Screw Pitch, Taper, Telescoping Thickness

Brown & Sharpe Mfg. Co., Providence, R. I.

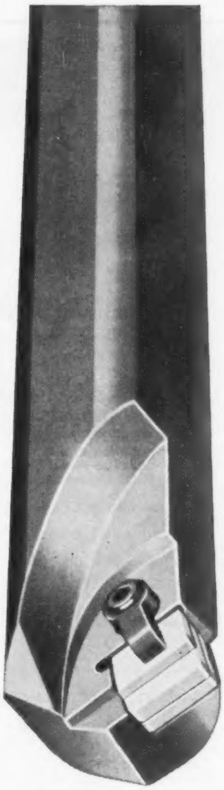
GAGES, Multiple Inspection

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio

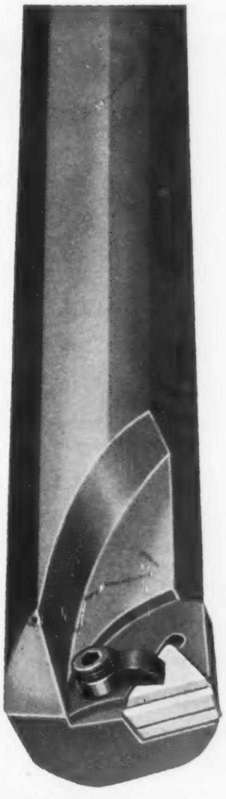
GAGES, Plug and Ring

Brown & Sharpe Mfg. Co., Providence, R. I.
Dearborn Gage Co., 22038 Beech St., Dearborn, Mich.
DoAll Co., Des Plaines, Ill.

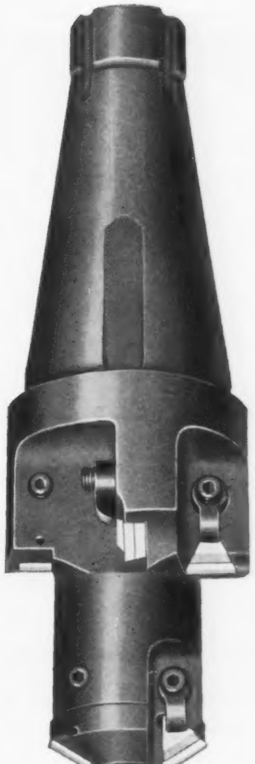
(Continued on page 338)



Square insert, 15-degree lead angle. Suitable for most boring operations.



Triangular insert for turning to a square shoulder handles other boring jobs.



Easily adapted to multiple insert boring heads for many specialized operations.

KENDEX*

BORING BARS

Kendex Boring Bars bring to turret lathe boring operations all the benefits and economies the Kendex principle is bringing to turning, facing and milling operations.

With the proper grade of Kennametal* "throw-away" inserts, bars can be used for both rough and finish boring of pieces up to several inches in diameter. Almost all boring operations can be handled with only two bars. Special designs are available for special jobs.

Ask for a Kennametal Tool Engineer to demonstrate the operation of this important new family of Kendex tools — or write for information. KENNAMETAL INC., Latrobe, Penna.

*Registered Trademark C-3057

INDUSTRY AND
KENNAMETAL
...Partners in Progress

OFFER THESE PRODUCTION BENEFITS

- Suitable for close-tolerance work. Tool can be adjusted while insert remains on center, even when small-diameter bars are used.
- Suitable for heavy stock removal . . . simple design . . . rugged construction . . . hardened alloy steel bar.
- Thinner inserts permit use of harder, more crater-resistant grades with minimized risk of failure due to thermal cracks.
- Cutting point brought down to bar center-line. Standard Kendex chip-breaker plate gives better chip control.

For more information fill in page number on Inquiry Card, on page 259

Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Van Keuren Co., Watertown, Mass.
Winter Bros. Co., Rochester, Mich.

GAGES, Pressure, Air and Hydraulic

Modern Industrial Eng. Co., 14230 Birwood Ave., Detroit 38, Mich.

GAGES, Roll Thread Snap, Adjustable Snap

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

GAGES, Surface Roughness

DoAll Co., Des Plaines, Ill.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, VERNIER, Height, Depth, Gear Tooth

Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Starrett Co., L. S., Athol, Mass.

GASKETS

Garlock Packing Co., Palmyra, N. Y.

GEAR BURNISHERS

Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHAMFERING, ROUNDING AND DEBURRING MACHINES

Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Modern Industrial Engrg. Co., 14230 Birwood, Detroit 4, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHECKING EQUIPMENT

Brown & Sharpe Mfg. Co., Providence, R. I.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES Bevel and Spiral

Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Worm and Worm Wheels

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cone Drive Gear Div., 7171 E. McNichols Rd., Detroit 12, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR GRINDERS—See Grinding Machines, Gear

GEAR HOBBERS

American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.

GEAR HONERS

National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.

GEAR LAPPERS
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

GEAR MOTORS—See Speed Reducers

GEAR RACKS
Gear Specialties, Inc., 2635 W. Medill Ave., Chicago 47, Ill.
Illinois Gear & Mch. Co., 2108 No. Natchez Ave., Chicago 35, Ill.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Stahl Gear & Mch. Co., The, 3901 Hamilton Ave., Cleveland 4, Ohio

GEAR SHAPERS
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

GEAR SHAVERS
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.

GEARS, AND GEAR BLANKS, Nonmetallic
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Gear Specialties, Inc., 2635 W. Medill Ave., Chicago 47, Ill.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
Illinois Gear & Mch. Co., 2108 No. Natchez Ave., Chicago 35, Ill.
New Jersey Gear & Mfg. Co., Hillside, N. J.
Philadelphia Gear Works, Erie Ave. and G St., Philadelphia, Pa.
Ryerson, Jos. T. & Son, Inc., 16th and Rockwell St., Chicago 8, Ill.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio

GEARS, Cut
Automotive Gear Works, Inc., South 8th & O St., Richmond, Ind.
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio
Cone Drive Gear Div., 7171 E. McNichols Rd., Detroit 12, Mich.
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Fairfield Mfg. Co., 2309 S. Earl Ave., Lafayette, Ind.
Gear Specialties, Inc., 2635 W. Medill Ave., Chicago 47, Ill.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
Horsburgh & Scott Co., 5114 Hamilton, Cleveland, Ohio
Illinois Gear & Mch. Co., 2100 No. Natchez Ave., Chicago 35, Ill.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
New Jersey Gear Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Perkins Machine & Gear Co., W. Springfield, Mass.
Philadelphia Gear Works, Erie Ave. and G St., Philadelphia, Pa.
Stahl Gear & Mch Co., 3901 Hamilton Ave., Cleveland 14, Ohio
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.

GENERATORS, Electric
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Reliance Electric & Engrg. Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio

GRADUATING MACHINES
Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.

GREASES—See Lubricating Oils and Greases

GRINDERS, Bench, Floor and Snag
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh, Pa.
Jones & Lamson Mch. Co., Springfield, Vt.
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
South Bend Lathe Works, South Bend 22, Ind.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Thor Power Tool Co., 175 N. State St., Aurora, Ill.
U. S. Burke Machine Tool Div., Brotherton Rd., Cincinnati 27, Ohio

GRINDERS, Carbide Tool
Arter Grinding Mch. Co., 15 Sagamore Rd., Worcester 5, Mass.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh, Pa.
Elox Corp. of Mich., Royal Oak 3, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

For more information fill in page number on Inquiry Card, on page 259

GRINDERS, Die and Mold
Norton Co., 1 New Bond St., Worcester 6, Mass.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Drill Point
Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

GRINDERS, Face Mill
Kearney & Trecker Corp., Milwaukee 14, Wis.
Mattison Machine Works, 545 Blackhawk Park Ave., Rockford, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

GRINDERS, Knife and Shear
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Portable Electric
Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Standard Electrical Tool Co., 2488-90 River, Cincinnati 4, Ohio
Thor Power Tool Co., 175 N. State St., Aurora, Ill.

GRINDERS, Portable Pneumatic
Chicago Pneumatic Tool Co., New York 17, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Madison-Kipp Corp., Madison, Wis.
Thor Power Tool Co., Aurora, Ill.

GRINDERS, Tap
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
Rockford Die & Tool Wks., Inc., Rockford, Ill.

GRINDERS, Tool and Cutter
Atlas Press Co., 20108 N. Pitcher, Kalamazoo, Mich.
Barber-Colman Co., Rock and Montague, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh, Pa.
Elox Corp. of Mich., Royal Oak 3, Mich.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids 4, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.
Homestrand, Inc., Larchmont, N. Y.
Landis Tool Co., Waynesboro, Pa.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
South Bend Lathe Wks., South Bend 22, Ind.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio

GRINDERS, Toolpost

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING GAGES—See Gages, Grinding

GRINDING MACHINES, Abrasive Belt

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Mch. Works, Rockford, Ill.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Thor Power Tool Co., 175 N. State St., Aurora, Ill.
Walls Sales Corp., 333 Nassau Ave., Brooklyn 22, N. Y.

GRINDING MACHINES, Broach

Colonial Broach & Machine Co., P. O. Box 37, Harper Sta., Detroit 13, Mich.
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
Lapointe Mch. Tool Co., 34 Tower St., Hudson, Mass.
National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder, 1534 W. Main, Springfield, Ohio

GRINDING MACHINES, Cam

Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Mch. Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Centerless

Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Landis Tool Co., Waynesboro, Pa.
Triplex Machine Tool Corp., 75 West St., New York 6, N. Y.
Van Norman Mch. Co., Springfield, Mass.

GRINDING MACHINES, Crankshaft

Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Mch. Co., Springfield, Mass.

GRINDING MACHINES, Cylindrical

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Arter Grinding Mch. Co., 15 Sagamore Rd., Worcester 5, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Frauenthal Div., Muskegon, Mich.
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
Landis Tool Co., Inc., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio
Van Norman Co., 2640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Disc

Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tools Div., 400 Lexington Ave., Pittsburgh 8, Pa.
Gardner Machine Co., Beloit, Wis.
Mattison Machine Works, Rockford, Ill.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J

(Continued on page 344)

Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Gear

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gear Grinding Mch. Co., 3901 Christopher St., Detroit 11, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Lees-Bradner Co., Cleveland, Ohio
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Internal

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Arter Grinding Mch. Co., 15 Sagamore Rd., Worcester 5, Mass.
Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Frauenthal Div., Muskegon, Mich.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Van Norman Mch. Co., Springfield, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

GRINDING MACHINES, Jig

Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

GRINDING MACHINES, Profile

Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Roll

Landis Tool Co., Waynesboro, Pa.

GRINDING MACHINES, Surface Reciprocating

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Delta Power Tool Div., 400 Lexington Ave., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
Elox Corp. of Mich., Royal Oak 3, Mich.
Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8, Ohio
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids 4, Mich.
Gardner Machine Co., Beloit, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Homestrand, Inc., Larchmont, N. Y.
Mattison Machine Works, Rockford, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Van Norman Mch. Co., Springfield, Mass.

GRINDING MACHINES, Surface Rotary

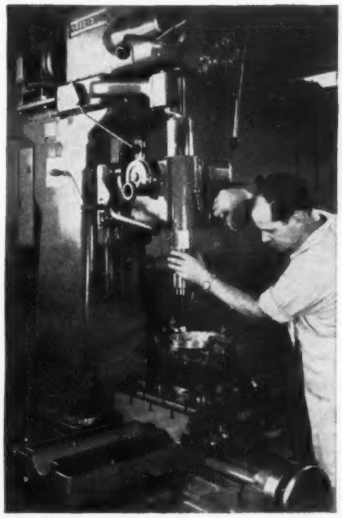
Arter Grinding Mch. Co., 15 Sagamore Rd., Worcester 5, Mass. (Rotary)

(Continued on page 346)

CLEEREMAN

DRILLING MACHINES

A battery of box column and round column Cleereman Drilling Machines on production work. One of many such installations producing at lower costs with higher production, less operator fatigue and no down time.

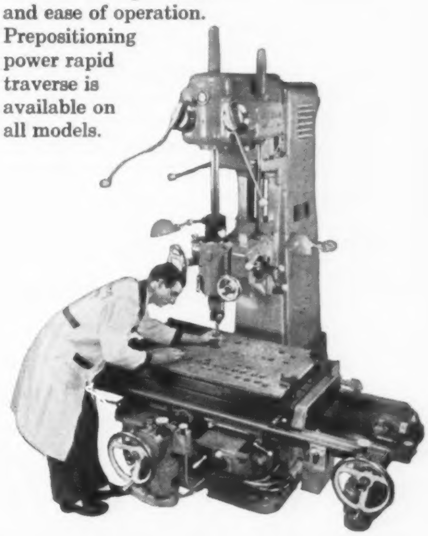


LAYOUT DRILLING MACHINE

A modern solution to an old problem. Built for those tool room and manufacturing jobs which do not require the ultra precision of Cleereman Jig Borers. The Cleereman Layout Machine is an economical machine capable of locating within .001" per foot and drilling, boring, reaming, tapping, etc., with utmost operator ease at a fast rate of production.

JIG BORER

Unexcelled precision for ultra-fine tolerances on highest quality gage, tool, die, jig and fixture work and on "jigless" production. Combines stamina with precision and ease of operation. Prepositioning power rapid traverse is available on all models.



BRYANT
Machinery & Engineering
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General Office
555 West Washington Blvd., Chicago 6
Representatives in Principal Cities

CLEEREMAN MACHINE TOOL CORP., Green Bay, Wis.

For more information fill in page number on Inquiry Card, on page 259

Blanchard Machine Co., 64 State St., Cambridge, Mass.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Van Norman Mch. Co., Springfield, Mass.
Walker, O. S., Co., Inc., Worcester, Mass.

GRINDING MACHINES, Thread

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch Co., Springfield, Vt.
Landis Machine Co. (Centerless), Waynesboro, Pa.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Universal

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Frauenthal Div., Muskegon, Mich.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 2, Mich.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Parker-Majestic, Inc., 147 Joseph Campau, Detroit, Mich.
Springfield Mch. Tool Co., 613 W. Southern Ave., Springfield, Ohio

GRINDING WHEEL DRESSING AND FORMING DEVICES

Besly-Welles Corp., 112 Dearborn Ave., Beloit, Wis.
DoAll Co., Des Plaines, Ill.
Jones & Lamson Mch. Co., Springfield, Vt.
Metal Carbides Corp., Youngstown, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING WHEELS

Besly-Welles Corp. (Abrasive Div.), 20 N. Wacker Drive, Chicago 6, Ill.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Carborundum Co., Niagara Falls, N. Y.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cincinnati Milling Products Div., Cincinnati 9, Ohio
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Gardner Machine Co., Beloit, Wis.
Macklin Co., Jackson, Michigan
Metal Carbides Corp., Youngstown, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony and Fraley St., Bridgesburg, Philadelphia, Pa.

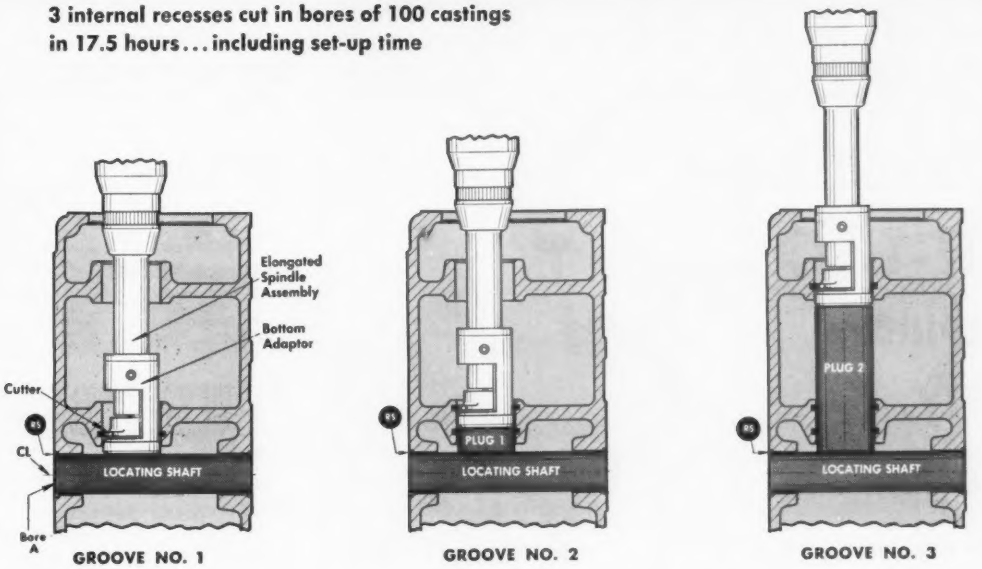
GROOVING TOOLS, Internal

Scully-Jones & Co., 1906 So. Rockwell St., Chicago 8, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

HAMMERS, Drop—See Forging Hammers

Waldes Truarc Grooving Tool pays for itself with big savings on one small run!

3 internal recesses cut in bores of 100 castings in 17.5 hours... including set-up time



GROOVE NO. 1 **GROOVE NO. 2** **GROOVE NO. 3**

The job shown above called for three grooves located at prescribed distances from center-line CL of bore A. Depth and location tolerances: $\pm.0015''$.

Size and shape of the castings made nesting difficult for a boring bar operation. Exterior surfaces were unmachined, making alignment complicated. With two grooves over 7" from the housing's open end, boring bar chatter could have caused costly rejects.

To overcome these obstacles a Waldes Truarc Grooving Tool was equipped with an elongated spindle assembly and bottom adaptor. The tool was mounted in a drill press, the castings in a large vise. Grooves were then cut as follows:

Groove No. 1: A locating shaft was inserted into bore A as a reference surface and the tool piloted into the housing until the bottom adaptor banked on the shaft. The tool is designed so that the cutter rotates in a neutral position until additional downward pressure is applied. It then moves into cutting position until preset groove depth is reached, after which the tool idles. Release of pressure returns the cutter to neutral so that the tool may be withdrawn.

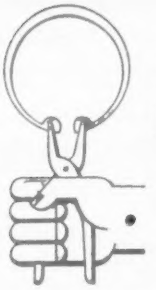
Groove No. 2: Plug 1 was inserted into the bore over the locating shaft and the tool again piloted into the bore. The groove was then cut the same way as Groove No. 1.

Groove No. 3: Plug 2 was substituted for the first plug and the cutting operation repeated.

All 300 grooves were held to prescribed tolerances. Set-up time: exactly 11 minutes. Operating time: 1050 minutes for 100 castings. Rejects: none!

No recessing problem is too tough for the amazingly versatile Waldes Truarc Grooving Tool. It's so simple even unskilled labor can use it accurately.

Write for a 20-page manual containing full information on Waldes Truarc Grooving Tool.



WALDES
TRUARC®
GROOVING TOOL

U.S. Pat. 2,411,426.

WALDES KOHINOOR, INC., 47-16 Austel Place, L.I.C. 1, N.Y.

Waldes Kohinoor, Inc.
47-16 Austel Pl., L. I. C. 1, N. Y.

Please send me your new 20-page technical manual on the Waldes Truarc Grooving Tool. (GT-2-53)

Name____________________

Title____________________

Company____________________

Address____________________

City__________ Zone____ State________

M079

For more information fill in page number on Inquiry Card, on page 259

HAMMERS, Portable Electric
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Thor Power Tool Co., Aurora, Ill.

HAMMERS, Portable Pneumatic
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Thor Power Tool Co., 175 N. State St., Aurora, Ill.

HAMMERS, Power
Chambersburg Engrg. Co., Chambersburg, Pa
Edlund Mchry. Co. Div., Cortland, N. Y.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

HARDENING FURNACES
General Electric Co., Schenectady, N. Y.
Holcroft & Co., 6545 Epworth Blvd., Detroit 10, Mich.

HARDNESS TESTERS
Shore Instrument & Mfg. Co., 90-35C Van Wyck Exp., Jamaica 35, N. Y.
Wilson Mechanical Instrument Co., Inc., 230-D Park Ave., New York, N. Y.

HEAT-TREATING EQUIPMENT—See Annealing Furnaces, Flame Hardening Machines, Induction-heating Equipment

HOBS
Barber-Colman Co., Rock and Montague, Rockford, Ill.
Goddard & Goddard Co., Detroit, Mich.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Twist Drill & Tool Co., Rochester, Mich.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Star Cutter Co., 34500 Grand River, Farmington, Mich.

HOISTS, Air
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Thor Power Tool Co., Aurora, Illinois

HOISTS, Electric
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

HONING MACHINES
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Micromatic Hone Corp., 8100 Schoolcraft, Detroit 4, Mich.
Moline Tool Co., 102-20th St., Moline, Ill.
Van Norman Mch. Co., 3640 Main St., Springfield 7, Mass.

HONING STONES
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.

HOSE
American Metal Hose Br. American Brass Co., 25 Broadway, New York, N. Y.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

HYDRAULIC MACHINERY
Tools and equipment
Baldwin-Lima-Hamilton Corp., Eddystone Div., Philadelphia 42, Pa.
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Bethlehem Steel Corp., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.

Bliss, E. W., Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engrg. Co., Chambersburg, Pa.
Colonial Broach & Machine Co., P.O. Box 37, Harper Sta., Detroit 13, Mich.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Denison Engrg. Co., 1160 Dublin St., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., Erie, Pa.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Engrg. Corp., Kenmore Station, Buffalo, N. Y.
Michigan Drill Head Co., Detroit 34, Mich.
Modern Ind. Engrg. Co., 14230 Birwood Ave., Detroit 4, Mich.
Motch & Merryweather Machinery Co., Penton Bldg., Cleveland, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Vickers Incorporated, Div. of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Watson-Stillman Co., Roselle, N. J.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

HYDRAULIC POWER UNITS OR TOOL HEADS

Barnes Drill Co., 814 Chestnut, Rockford 3, Ill.
Barnes, W. F. & John Co., 201 S. Waterford St., Rockford, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Incorporated, Div. of Sperry Rand Corporation, 1402 Oakman Blvd., Detroit, Mich.

INDEXING and SPACING EQUIPMENT

Austin Industrial Corp., White Plains, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Morris, Robert E. Co., 76 Mamaroneck Ave., White Plains, N. Y.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Robbins, Omer E. Co., 24800 Plymouth Rd., Detroit 39, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Van Norman Mch., 3640 Main St., Springfield 7, Mass.
Wadell Equip. Co., Clark, N. J.
Western Machine Tool Works, Holland, Mich.

INDICATOR BASES, Magnetic

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoAll Co., Des Plaines, Ill.
duMont Corp., 289 Wells St., Greenfield, Mass.
Starrett, L. S., Co., Athol, Mass.

INDICATOR LIGHTS—See Lights, Indicator

INDICATORS, Dial

Ames, B. C., Waltham 54, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Federal Products Corp., P. O. Box 1027, Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
National Automatic Tool Co., S. 7th-N. Sts., Richmond, Ind.

Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Starrett, The L. S. Co., Athol, Mass.

INDICATORS, Speed

Brown & Sharpe Mfg. Co., Providence, R. I.
General Electric Co., Schenectady, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Reliance Elec. & Engrg. Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio
Starrett, The L. S., Co., Athol, Mass.

INDICATORS, Test

Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., P. O. Box 1027, Providence, R. I.
National Automatic Tool Co., S. 7th & N Sts., Richmond, Ind.

Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Starrett, The, L. S., Co., Athol, Mass.

INDUCTION HEATING EQUIPMENT

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
General Electric Co., Schenectady, N. Y.
Lepel High Frequency Laboratories, Inc., Woodside 77, N. Y.
Ohio Crankshaft Co., 3800 Harvard Ave., Cleveland, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

INSPECTION EQUIPMENT, Ultrasonic

Curtiss-Wright Corp., Caldwell, N. J.

INTENSIFIERS, Hydraulic

Hydraulic Press Mfg. Co., Mount Gilead, Ohio

Logansport Mch. Co., Inc., Logansport, Ind.
Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wis.
Watson-Stillman Co., Roselle, N. J.

JACKS, Planer—See Set-up Equipment

JIG BORERS

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
American Sip Corp., 100 E. 42nd St., New York 17, N. Y.
Cleereman Machine Tool Co., Green Bay, Wis.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Homestrand, Inc., Larchmont, N. Y.
M. B. I. Export & Import, Ltd., 475 Grand Concourse, New York 51, N. Y.
Moore Special Tool Co., Inc., 724 Union Ave., Bridgeport, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

JIGS AND FIXTURES

Bath, Cyril Co., Aurora & Solon Road, Solon, Ohio
Columbus Die Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Metal Carbides Corp., Youngstown 12, Ohio
Modern Industrial Engrg. Co., 14230 Birwood Ave., Detroit 28, Mich.
Portage Mch. Co., 1025 Sweitzer Ave., Akron 11, Ohio
Robbins, Omer E. Co., 24800 Plymouth Rd., Detroit 39, Mich.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

KEYSEATERS

Baker Bros., Inc., Station F, P. O. Box 101, Toledo 10, Ohio
Bliss, E. W. Co., Canton, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Davis Keyseater Co., 405 Exchange St., Rochester 8, N. Y.
Heller Tool Co., Heller Dr., Newcomerstown, Ohio
Mitts & Merrill, 1809 S. Water St., Saginaw, Mich.

KNURLING TOOLS

Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 30, Illinois
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350 Worcester 1, Mass.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

LAPPING MACHINES

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill. (Lapmaster Div.)
DoAll Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gleason Works, 1000 University Ave., Rochester, N. Y.
Micromatic Hone Corp., 8100 Schoolcraft, Detroit 4, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Size Control Co., Div. of American Gage & Mch. Co., 2500 W. Washington Blvd., Chicago 12, Ill.

LATHE ATTACHMENTS

Atlas Press Co., Kalamazoo, Mich.
Axelson Mfg. Co., P. O. Box 15335, Vernon Sta., Los Angeles 58, Calif.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch., 512 Clinton St., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

LATHES, AUTOMATIC—See Chucking Machines

LATHES, Axle

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Consolidated Mch. Tool Div., Farrel-Birmingham Co., Inc., Rochester 10, N. Y.
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Morey Machinery Co., 383 Lafayette St., New York 3, N. Y.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Bench

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Homestrand, Inc., Larchmont, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Levin, Louis & Son, Los Angeles 21, Calif.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.

LATHES, Car Wheel

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Bullard Co., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.

LATHES, Copying, Duplicating

Pilot Div., Cone Automatic Mch. Co., 30 Rockefeller Plaza, New York, N. Y.

LATHES, Crankshaft

Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Wickes Brothers, 512 No. Water St., Saginaw, Mich.

LATHES, Double-End

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Wickes Brothers, 512 No. Water St., Saginaw, Mich.

LATHES, Duplicating

Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Calif.
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Sidney Machine Tool Co., Sidney, Ohio
Triplex Machine Tool Corp., 75 West St., New York 6, N. Y.

LATHES, Engine, Manufacturing

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Atlas Press Co., Kalamazoo, Mich.
Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Calif.
Barber-Colman Co. (Hendey Mch. Div.), Rockford, Ill.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Eustacchio, S., Brescia, Italy
Homestrand, Inc., Larchmont, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio

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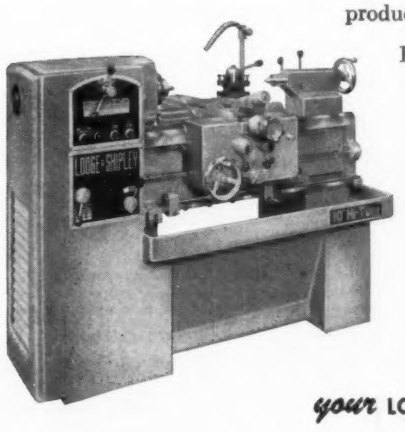

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Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
Sidney Machine Tool Co., Sidney, Ohio
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Springfield Mch. Tool Co., Springfield, Ohio
Western Machine Tool Works, Holland, Mich.
Wickes Brothers, 512 No. Water St., Saginaw, Mich.

LATHES, Engine, Toolroom

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Atlas Press Co., Kalamazoo, Mich.
Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Calif.
Barber-Colman Co. (Hendey Mch. Div.), Rockford, Ill.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.
Homestrand, Inc., Larchmont, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
Sidney Machine Tool Co., Sidney, Ohio
South Bend Lathe Works Inc., 425 E. Madison St., South Bend, Ind.
Springfield Mch. Tool Co., Springfield, Ohio
Western Machine Tool Works, Holland, Mich.
Wickes Brothers, 512 No. Water St., Saginaw, Mich.

LATHES, Gap

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Atlas Press Co., Kalamazoo, Mich.
Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Calif.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Oakley, Cincinnati 9, Ohio
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Homestrand, Inc., Larchmont, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Sidney Machine Tool Co., Sidney, Ohio
Springfield Mch. Tool Co., Springfield, Ohio

LATHES, Hollow Spindle

Axelson Mfg. Co., P. O. Box 15335, Vernon Sta., Los Angeles 58, Calif.
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
South Bend Lathe Works Inc., 425 E. Madison St., South Bend, Ind.

LATHES, Roll

American Tool Works Co., Cincinnati 2, Ohio
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Bliss, E. W., Co., Canton, Ohio
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio

LATHES, Speed, Second-operation

Atlas Press Co., Kalamazoo, Mich.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., Cincinnati 25, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio

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Seneca Falls Mch. Co., Seneca Falls, N. Y.
Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

LATHES, Spinning

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Lodge & Shipley Co., The, Cincinnati 25, Ohio

LATHES, Toolroom—See Lathes, Engine, Toolroom

LATHES, Turret, Automatic

Atlas Press Co., Kalamazoo, Mich.
Bullard Co., Brewster St., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.

LATHES, Turret, Ram Type, Saddle Type

Atlas Press Co., Kalamazoo, Mich.
Bardons & Oliver Inc., Ft. W. 9th St., Cleveland 13, Ohio
Bullard Co., Brewster St., Bridgeport 2, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Levin & Son, Inc., Louis, Los Angeles 8, Calif.
Morey Machinery Co., 383 Lafayette St., New York 3, N. Y.
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
Seneca Falls, Mch. Co., Seneca Falls, N. Y.
Sheldon Mach. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
South Bend Lathe Wks., South Bend 22, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

LATHES, Turret Vertical—See Boring Mills, Vertical

LAYOUT and DRAFTING TOOLS

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Lufkin Rule Co., Saginaw, Mich.
Starrett, L. S., Co., Athol, Mass.

LEVELS

Lufkin Rule Co., Saginaw, Mich.
South Bend Lathe Wks., South Bend 22, Ind.
Starrett, The L. S., Co., Athol, Mass.

LIGHTS, Indicator

General Electric Co., Schenectady, N. Y.

LIMIT SWITCHES—See Switches, Limit

For more information fill in page number on Inquiry Card, on page 259


CHAMBERSBURG
CECOSTAMP
6
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LUBRICATING OILS and GREASES
Cities Service Oil Co., 70 Pine St., New York, N. Y.
Lubriplate Div., Fiske Bros. Refining Co., 120 Lockwood St., Newark 5, N. J.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan, Chicago, Ill.
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia, Pa.
Texas Co., 135 E. 42nd St., New York, N. Y.

LUBRICATING SYSTEMS
Farval Corp., 3249 E. 80th St., Cleveland, Ohio
Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave., Chicago 23, Ill.
Madison-Kipp Corp., Madison, Wis.
Onsrud Machine Works, Inc., Niles, Ill.

MACHINERY, Used and Rebuilt
Eastern Mchry. Co., 1000 Tennessee Ave., Cincinnati, Ohio
Miles Mchry. Co., 2025 E. Genessee Ave., Saginaw, Mich.
Van Keuren Co., Watertown 72, Mass.
Williams, J. H., & Co., 400 Vulcan St., Buffalo 7, N. Y.

MACHINISTS' SMALL TOOLS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Lufkin Rule Co., Saginaw, Mich.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Starrett, The, L. S., Co., Athol, Mass.

MANDRELS—See Arbors and Mandrels

MARKING MACHINES and DEVICES
Colonial Broach & Machine Co., P. O. Box 37, Harper Sta., Detroit 13, Mich.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MATERIAL-HANDLING TRUCKS—See Trucks, Material Handling

MEASURING MACHINES
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio
Van Keuren Co., Watertown 72, Mass.

MEASURING WIRES, Thread, Spline, Gear
Sheffield Corp., Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Van Keuren Co., Watertown 72, Mass.

MICROMETER HEADS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoAll Co., Des Plaines, Ill.
Starrett, The L. S., Co., Athol, Mass.

MICROMETERS, Outside, Inside, Depth
Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Starrett, The L. S., Co., Athol, Mass.
Van Keuren Co., Watertown 72, Mass.

MICROSCOPES, Toolmakers'
Bausch & Lomb Optical Co., Rochester, N. Y.
DoAll Co., Des Plaines, Ill.
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

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MILLING MACHINE ATTACHMENTS

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gorton, George, Mch. Co., 1110 W. 13th St., Racine, Wis.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Homestrand, Inc., Larchmont, N. Y.
Kearney & Trecker Corp., Milwaukee, Wis.
Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Van Noman Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Automatic

Cincinnati Milling Machine Co., Cincinnati, Ohio
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
Kearney & Trecker Corp., Milwaukee, Wis.
Marac Machinery Corp., Yonkers, N. Y.
Millholland, W. K., Machinery Co., 6402 Westfield Blvd., Indianapolis 5, Ind.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.

MILLING MACHINES, Bench, Hand

Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Morris, Robert E., Co., 76 Mamaroneck Ave., White Plains, N. Y.

MILLING MACHINES, Bed Type, Simplex, Duplex

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Cincinnati Milling & Grinding Mches., Inc., 470 Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Mch. Wrks, Front St. and Girard Ave., Philadelphia, Pa.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Morey Machinery Co., 383 Lafayette St., New York 3, N. Y.
Morris, Robert E. Co., 76 Mamaroneck Ave., White Plains, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.
Van Norman Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Circular, Continuous

Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.
Espen-Lucas Mch. Works, Front St., and Girard Ave., Philadelphia, Pa.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Die Sinking, Duplicating, Profiling

Arrow Engineering Co., Inc., 120 E. Market St., Indianapolis, Ind.
Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Calif.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Colonial-Romulus Div., Parkgrove Station, Detroit 5, Mich.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.

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For more information fill in page number on Inquiry Card, on page 259

Elox Corp. of Mich., 1830 Stephenson Highway, Royal Oak 3, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gorton, George, Machine Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., Milwaukee, Wis.
Morey Machinery Co., 383 Lafayette St., New York, 3, N. Y.
Onsrud Machine Works, Inc., Niles, Ill.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.

MILLING MACHINES, Knee Type, Horizontal, Plain, Universal

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Austin Industrial Corp., 76 Mamaroneck Ave., White Plains, N. Y.
Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Calif.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Ferndale, Mich.
Gorton, Geo., Mch. Co., 1110 W. 13th St., Racine, Wis.
Greaves Machine Tool Div., 2009 Eastern Ave., Cincinnati, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Homestrand, Inc., Larchmont, N. Y.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheldon Machine Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
Van Norman Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Rise and Fall

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Homestrand, Inc., Larchmont, N. Y.
Kearney & Trecker Corp., Milwaukee, Wis.
Nichols-Morris Corp., 76 Mamaroneck Ave., White Plains, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

MILLING MACHINES, Knee Type Ram

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., Milwaukee, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Turret

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MILLING MACHINES, Knee Type, Vertical

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Atlas Press Co., Kalamazoo, Mich.
Austin Industrial Corp., 76 Mamaroneck Ave., White Plains, N. Y.
Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Calif.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 450 Lexington Ave., New York 17, N. Y.
Gorton, Geo., Mch. Co., 1110 W. 13th St., Racine, Wis.
Homestrand, Inc., Larchmont, N. Y.
Kearney & Trecker Corp., Milwaukee, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
South Bend Lathe Wks., South Bend 22, Ind.

MILLING MACHINES, Planer Type

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio

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Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., Woodburn Ave. and Penn R. R., Evanston, Cincinnati, Ohio
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Morey Machinery Co., 383 Lafayette St., New York 3, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.

MILLING MACHINES, Spar

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
G & L and Hypro Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Kearney & Trecker Corp., Milwaukee, Wis.
Morey Machinery Co., 383 Lafayette St., New York 3, N. Y.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.

MILLING MACHINES, Thread

Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.

MOLDING MACHINES, Plastic

Baker Bros., Inc., 1000 Post St., Toledo 10, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Watson-Stillman Co., Roselle, N. J.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

MOTORS, Electric

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
General Electric Co., Schenectady, N. Y.
Howell Electric Motors Co., Howell, Mich.
Lincoln Electric Co., Cleveland 17, Ohio
Reliance Electric & Engrg. Co., 1074 Ivanhoe Rd., Cleveland 10, Ohio

MOTORS, Hydraulic

Barnes, J. S., Corp., Rockford, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee Wis.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.
Vickers, Inc., Detroit 32, Mich.

MULTIPLE INSPECTION GAGES—See Gages, Multiple Inspection

MULTIPLE-STATION MACHINES, Dial Type

Avey Drilling Mch. Co., 25 E. 3rd St., Covington, Ky.
Baker Bros., Inc., 1000 Post St., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Federal Prod. Corp., 1144 Eddy St., Providence 1, R. I.
Greenlee Bros. & Co., 2136 - 12th St., Rockford, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Kingsbury Mch. Tool Corp., Keene, N. H.
LaSalle Tool, Inc., 3840 E. Outer Drive, Detroit 34, Mich.
Modern Industrial Engrg. Co., 14230 Birwood Ave., Detroit 38, Mich.

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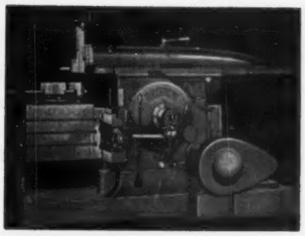
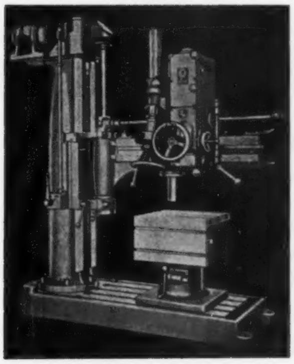


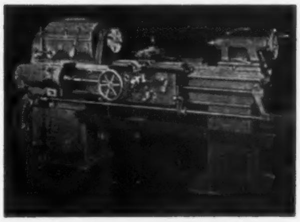
GARVIN Automatic Tappers —4 Spindle Speeds—Up to 3″ Pipe Tap — Timken Roller Bearing Equipped — Left or Right Hand Tapping.

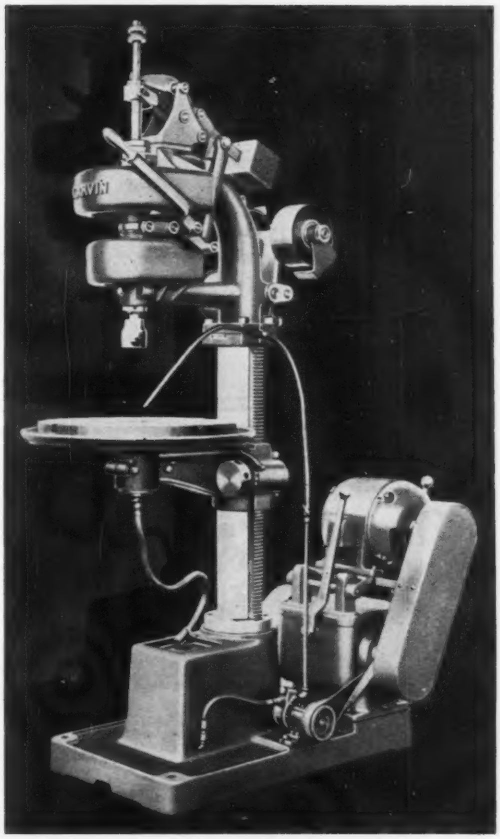


STEPTOE SHAPERS — 14″ to 24″ Heavy Duty; 12″ and 15″ High Speed, up to 200 strokes per minute.

WESTERN RADIAL DRILLS — Heavy Duty, 3 to 8 ft., 16 or 32 speeds. High Speed, 3 to 6 ft., 6, 9, 12 or 18 speeds.

CHARD LATHES — Quick change, geared head; 16″, 18″ and 20″ swing, 8 or 12 speeds.





THE BIG 4 WESTERN LINE

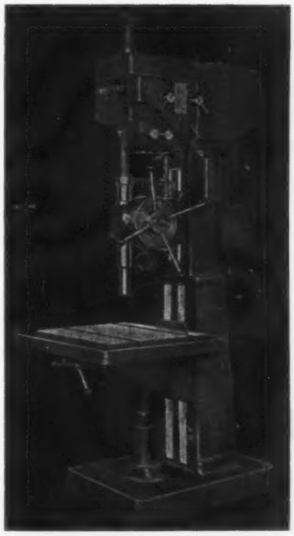
"RELIABLE–SINCE 1895"

With **GARVIN Tappers** "the operator's responsibility ends at the starting lever." With one simple pull on the lever, tap enters the pre-drilled hole, taps to the depth required, reverses and backs out the tap in preparation for another cycle. Reversal of tap rotation is instantaneous, thereby not stripping the last thread. The precision depth tripping device is positively and easily set by any operator. Spindle driving pulleys, rear idler pulleys and the entire speed box are mounted on Timken bearings; spray lubrication is provided within the speed box together with convenient speed-selection levers. Five sizes from machine screws to 3″ pipe taps.

For more information on these and other machines in the Big 4 line write for catalogs. Specify capacity desired.

MANUFACTURED BY

WESTERN MACHINE TOOL WORKS
HOLLAND, MICHIGAN, U.S.A.



WESTERN UPRIGHT DRILLS — Single or multiple spindle; 18 speeds; 9 feeds; all geared; up to 2½″ capacity.

For more information fill in page number on Inquiry Card, on page 259

National Automatic Tool Co., S. 7th N. Sts., Richmond, Ind.
Snyder Tool & Engrg. Co., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

MULTIPLE-STATION MACHINES, Transfer Type

Avey Drilling Mch. Co., 25 E. 3rd St., Covington, Ky.
Baker Bros., Inc., 1000 Post St., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Watson Ave., Springfield, Mass.
Buhr Mch. Tool Co., 839 Green St., Ann Arbor, Mich.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling Mch. Co., Cincinnati 9, Ohio
Clearing Mch. Corp., 6499 W. 65th St., Chicago 38, Ill.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenlee Bros. & Co., 2136 - 12th St., Rockford, Ill.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Kearney & Trecker Corp., Milwaukee, Wis.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Modern Industrial Engrg. Co., 14230 Birwood Ave., Detroit 38, Mich.
Moline Tool Co., 102-20th St., Moline, Ill.
National Automatic Tool Co., S. 7th N. Sts., Richmond, Ind.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Snyder Tool & Engrg. Co., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.
Verson Allsteel Press Co., 9399 S. Kenwood Ave., Chicago 19, Ill.

NIBBLING MACHINES

Thor Power Tool Co., 175 N. State St., Aurora, Ill.
Wales-Strippit Corp., Akron, N. Y.

NICKEL AND NICKEL ALLOYS

Crucible Steel Co. of America, Henry W. Oliver Bldg., Mellon Square, Pittsburgh 22, Pa.

OIL GROOVERS

Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

OILERS AND LUBRICATORS

Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago, Ill.
Madison-Kipp Corp., Madison, Wis.
Wicaco Mch. Corp., Philadelphia, Pa.

OILS, Quenching and Tempering

Cities Service Oil Co., 70 Pine St., New York, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 600 - 5th Ave., New York, N. Y.
Standard Oil Co (Indiana), 910 S. Michigan Ave., Chicago 80, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.

OPTICAL FLATS

Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill.
DoAll Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Van Keuren Co., Watertown 72, Mass.

PACKING, Leather, Metal, Rubber, Asbestos, Etc.

Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill.
Watson-Stillman Co., Roselle, N. J.

PARALLELS

Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Lufkin Rule Co., Saginaw, Mich.
Starrett, The L. S., Co., Athol, Mass.
Walker, O. S., Co., Inc., Worcester, Mass.

PATTERNS, Wood and Metal

Mummert-Dixon Co., Hanover, Pa.

PIPE, Steel, Stainless, etc.

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Babcock & Wilcox Co. (Tubular Prod. Div.), Beaver Falls, Penna.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Pa.
Crucible Steel Co. of America, Henry W. Oliver Bldg., Mellon Square, Pittsburgh 22, Pa.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
United States Steel Corp., National Tube Co., Div., 436 7th Ave., Pittsburgh, Pa.

PIPE AND TUBING MILLS, Electric-weld

Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

PIPE AND TUBING, Brass and Copper

American Brass Co., 25 Broadway, New York, N. Y.
Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.

PIPE THREADING AND CUTTING MACHINES

Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Landis Machine Co., Inc., Waynesboro, Pa.
Sheffield Machine Co., Inc., Waynesboro, Pa.

PLANER JACKS—See Set-up Equipment

PLANERS, Double Housing and Openside

Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Consolidated Mch. Tool Div., Rochester, N. Y.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., 3611 Woodburn Ave., Cincinnati, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.

PLASTICS AND PLASTIC PRODUCTS

Dow Chemical Co., Midland, Mich.
Eastman Kodak Co., 343 State St., Rochester 4, N. Y.
Gisholt Mch. Co., Madison, Wis.
U. S. Steel Corp., Nat'l Tube Div., Pittsburgh, Pa.

PRESS BRAKES—See Brakes, Presses and Bending

PRESS FEEDERS, Automatic

Bliss Co., E. W., Canton, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
U. S. Tool Co., East Orange, N. J.

PRESSES, Arbor

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
du Mont Corp., Greenfield, Mass.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hannifin Corp., 510 S. Wolf Rd., Des Plaines, Ill.
Logansport Machine Co., Inc., Logansport, Ind.
Threadwell Tap & Die Corp., 16 Arch St., Greenfield, Mass.
Watson-Stillman Co., Roselle, N. J.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Assembling

Bliss, E. W. Co., 1375 Raff Rd. S. W., Canton, Ohio
Colonial Broach & Machine Co., Box 37, Detroit 13, Mich.
Detroit Broach Co., Inc., 950 S. Rochester Rd., Rochester, Mich.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Ferracute Machine Co., Bridgeton, N. J.
Hannifin Corp., 510 S. Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

PRESSES, Blanking, Stamping

Alpha Press & Machine, Inc., 9281 Freeland Ave., Detroit 28, Mich.
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Bath, Cyril Co., 32324 Solon Rd., Solon, Ohio
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd. S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 S. Laramie, Chicago 50, Ill.
Federal Machine & Welder Co., 1745 Overland Ave. N. E., Warren, Ohio
Federal Press Co., 511 Division St., Elkhart Ind.
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
U. S. Tool Co., Inc., 255 N. 18th St., East Orange, N. J.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Briquetting

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Closed-Die Forging

Ajax Manufacturing Co., 1441 Chardon Rd., Cleveland 17, Ohio
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd. S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Coining, Embossing

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 S. Laramie, Chicago 50, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Die Sinking (Hobbing)

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St. Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Die Tryout

Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Ferracute Machine Co., Bridgeton, N. J.
Hannifin Corp., 510 S. Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Drawing

Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Cincinnati Milling & Grinding Machines, Inc., 4710 Marburg Ave., Cincinnati 9, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 S. Laramie, Chicago 50, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Extrusion

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Danly Machine Specialties, Inc., 2100 S. Laramie, Chicago 50, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Watson-Stillman Co., Roselle, N. J.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Foot

Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Arcade, N. Y.

PRESSES, Horning

Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton Ohio
Clearing Machine Corp., 6499 W. 65th St. Chicago 38, Ill.

(Continued on page 370)

all the EXTRAS are standard with T-J Spacemaker CYLINDERS

- **NEW** *exclusive* ingenious cushion designs . . . Super Cushion Flexible Seals for Air . . . New Self-Aligning Master Cushion for Oil.
- **STRONGER** than outmoded tie rod design, proven through actual tests. No tie rods to stretch.
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- **OIL** pressure to 750 p.s.i. AIR to 200 p.s.i.

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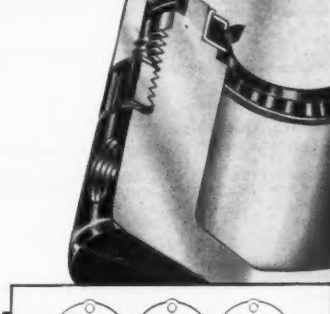

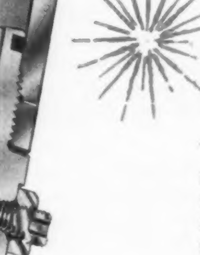

T-J TOMKINS-JOHNSON
RIVITORS AIR AND HYDRAULIC CYLINDERS CUTTERS CLINCHORS

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Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave. Chicago 19, Ill.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Notching

Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Ferracute Machine Co., Bridgeton, N. J.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
V & O Press Co., Hudson, New York
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wales-Strippit Corp., Akron, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Punching, Piercing

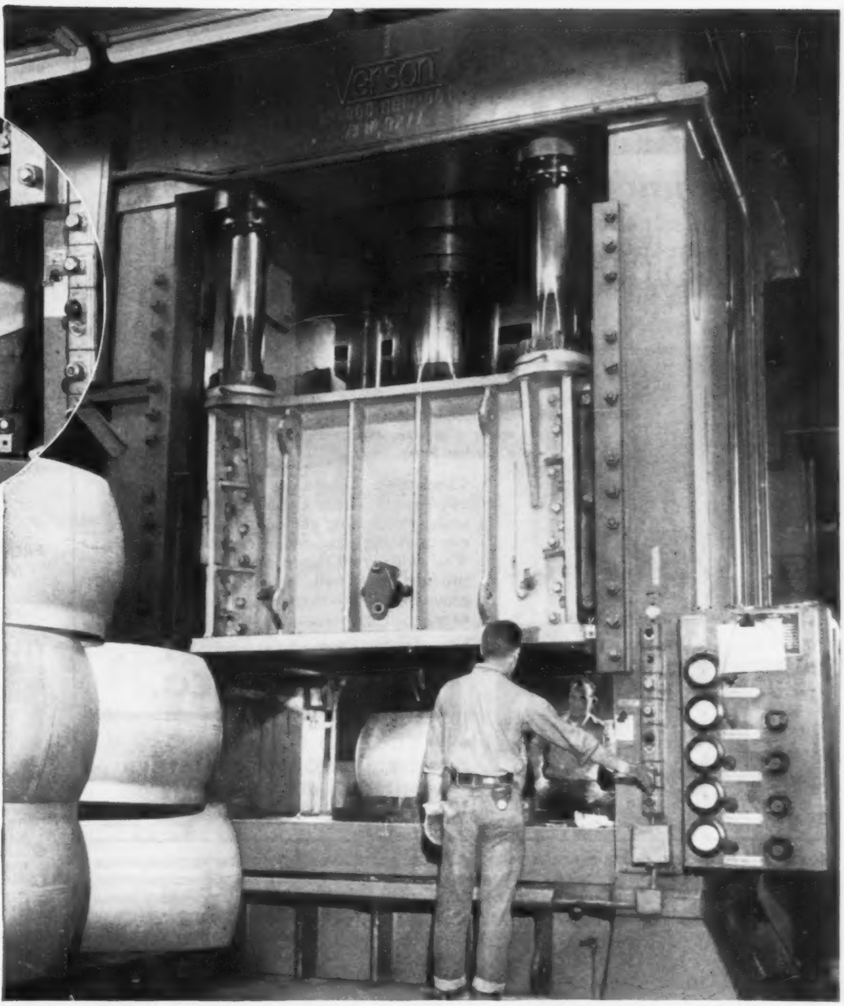
Bath Cyril Co., 32324 Aurora Rd., Solon, Ohio
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 S. Laramie, Chicago 50, Ill.
Dreis & Krump Mfg. Co., 7400 S. Loomis Blvd., Chicago 36, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Ferracute Machine Co., Bridgeton, N. J.
Hannifin Corp., 510 S. Wolf Rd., Des Plaines, Ill.
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Verson Allsteel Press Co., 9309 S. Kenwood, Chicago 19, Ill.
Wales-Strippit Co., Akron, N. Y.
Wiedemann Machine Co., 4272 Wissahicken Ave., Philadelphia 32, Pa.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Quenching

Gleason Wks., 1000 University Ave., Rochester 3, N. Y.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.

PRESSES, Rubber-Forming

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Cincinnati Milling & Grinding Machines, Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hannifin Corp., 510 S. Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.



Close-up of die space shows special expander die used in forming metal to smoothly rounded shape.

Nozzle support for J57 after burner is formed on Verson 1000 ton double action hydraulic press at Solar-Des Moines.

Another Verson Press proves its versatility

. . . forming jet engine components at Solar Aircraft Company

This is Verson versatility at work . . . a 1000 ton Verson double action hydraulic press . . . "workhorse" at Solar Aircraft Company's Des Moines plant.

Solar produces components for jet and turbo-jet engines which power a number of our best known aircraft. They are also engaged in the manufacture of components for guided missiles. To this end, a variety of tasks are assigned to this Verson Press, including heavy duty expanding, sheet metal embossing and deep drawing. Forming is done primarily with 300 series or 410 stainless steels, ranging in thickness from .031 to .093.

The double action press, largest of its type at Solar-Des Moines, has proved a rugged and versatile production tool. In addition to the heavy jobs, it handles general production when needed.

Big job . . . small job . . . there's a Verson press for you. For specific recommendations send an outline of your requirements.

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PRESSES, Trimming

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 S. Laramie, Chicago 50, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Machine & Welder Co., 1745 Overland Ave., N. E., Warren, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Ferracute Machine Co., Bridgeton, N. J.
Hannifin Corp., 510 S. Wolf Rd., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.

PROFILING MACHINES—See Milling Machine, Die Sinking, etc.

PULLEYS

Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.

PUMPS, Coolant and Lubricant

Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Graymills Co., 3705 N. Lincoln Ave., Evanston, Ill.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Ruthman Machinery Co., 1809 Reading Rd., Cincinnati 12, Ohio
Viking Pump Co., Cedar Falls, Iowa

PUMPS, Hydraulic

Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Denison Engrg. Co., 1160 Dublin St., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Vickers Incorporated, Division of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Viking Pump Co., Cedar Falls, Iowa
Watson-Stillman Co., Roselle, N. J.
Wilson, K. R., Arcade, N. Y.

PUNCHES AND DIES—See Dies, Blanking, etc.

REAMERS, Rose, Chucking, Jobbers', Taper, Shell, Adjustable, etc.

Barber-Colman Co., Rock and Montague, Rockford, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Goddard & Goddard Co., Detroit, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Heller Tool Co., Heller Dr., Newcomerstown, Ohio
National Twist Drill & Tool Co., & Winter Bros. Co., Rochester, Mich.
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.
Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich.

REELS, Stock

National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
Nilson, A. H. Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.

REFRACTORS, Heat-Treating Furnaces

Norton Co., 1 New Bond St., Worcester 6, Mass.

RETAINING RINGS FOR BEARINGS, Etc.

Waldes-Kohinoor, Inc., 4716 Austel Place, Long Island City 1, N. Y.

RIVETERS, Stationary

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Grant Mfg. & Mch. Co., 90 Silliman Ave., Bridgeport 5, Conn.
Hannifin Corp., 510 S. Wolf Rd., Des Plaines, Ill.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., New York 17, N. Y.
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

RIVETERS, Portable

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Hannifin Corp., 510 So. Wolf Rd., Des Plaines, Ill.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Thor Power Tool Co., Aurora, Ill.

RULES, SCALES AND STRAIGHTEDGES—See Machinists' Small Tools

RUST INHIBITORS

Oakite Products, Inc., 19 Rector St., New York N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Stuart, D. A. Oil Co. Ltd., 2727 S. Troy St., Chicago 23, Ill.
Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.

SAND BLAST EQUIPMENT—See Blast Cleaning Equipment

SAW BLADES, Hack, Band, Circular, Friction

Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Espen-Lucas Mach. Works, Philadelphia, Pa.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Starrett, The L. S. Co., Athol, Mass.
Tannewitz Works, Grand Rapids, Mich.

SAW BLADE SHARPENERS

DoAll Co., Des Plaines, Ill.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

SAWING MACHINES, Abrasive Machines—See Cutting-off Saws, Abrasive Wheel

SAWING MACHINES, Band

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Tannewitz Works, Grand Rapids, Mich.

SAWING MACHINES, Circular Blade

Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Delta Power Tool Div., Rockwell Mfg. Co., 614G N. Lexington Ave., Pittsburgh 8, Pa.
DoAll Co., 254 Laurel Ave., Des Plaines, Ill.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.

SAWING MACHINES, Power Hack

Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Chicago Pneumatic Tool Co., New York 17, N. Y.
Homestrand, Inc., Larchmont, N. Y.
Thor Power Tool Co., 175 N. State St., Aurora, Ill.

SAWS, Screw-slotting—See Cutters, Milling

SCALES

Hydroway Scales, Inc., 31302 Stephenson Hwy., Madison Hts., Mich.

SCREW DRIVERS, STUD AND NUT SETTERS, Power

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Errington Mech Lab., Inc., 24 Norwood Ave., Staten Island 4, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Scully-Jones & Co., 1906 S. Rockwell St., Chicago 8, Ill.
Thor Power Tool Co., Aurora, Illinois
Williams & Co., J. H., 400 Vulcan St., Buffalo 7, N. Y.

SCREW MACHINES, Hand—See Lathes, Turret, Ram-type, Saddle-type

SCREW MACHINES, Single-Spindle Automatic

Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Cone Automatic Mch. Co., Inc., Windsor, Vt.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gear Grinding Mch. Co., 3901 Christopher St., Detroit 11, Mich.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, George, Mch. Co., 1110 W. 13th St., Racine, Wis.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Russell, Holbrook & Henderson, Inc., 292 Madison Ave., N. Y. 17, N. Y.

SCREW MACHINES, Multiple-Spindle Automatic

Cone Automatic Mch. Co., Inc., Windsor, Vt.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Warner & Swasey, 6701 Carnegie Ave., Cleveland 3, Ohio

SCREW PLATES

Greenfield Tap & Die Corp., Greenfield, Mass.

SCREWS, Cap, Set, Self-tapping, etc.—See Bolts, Nuts and Screws

SEALS AND RETAINERS, Oil or Grease

Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill.
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago, Illinois

SEPARATORS, Magnetic

Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

SET-UP EQUIPMENT

Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Challenge Mchry. Co., Grand Haven, Mich.
Lufkin Rule Co., Saginaw, Mich.
Starrett, The, L. S., Co., Athol, Mass.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

SHAFTS

Cumberland Steel Co, 101 Williams St., Cumberland, Md.
National Forge & Ordnance Co., Irvine, Warren County, Pa.
Thomson Ind., Inc., Manhasset, N. Y.

SHAPERS, Crank and Hydraulic

Austin Industrial Corp., 76 Mamaroneck Ave., White Plains, N. Y.
Cincinnati Shaper Co., Elam and Garrard Aves., Cincinnati, Ohio
Homestrand, Inc., Larchmont, N. Y.
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
South Bend Lathe Works, Inc., 425 E. Madison St., South Bend, Ind.
Western Machine Tool Works, Holland, Mich.

SHAPERS, Vertical and Slotters

Austin Industrial Corp., 76 Mamaroneck Ave., White Plains, N. Y.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Homestrand, Inc., Larchmont, N. Y.
Morey Machinery Co., 383 Lafayette St., New York 3, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.

SHEARS, Alligator

Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Lodge & Shipley Co., The, Cincinnati 25, Ohio

SHEARS, Rotary and Squaring

Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Cincinnati Shaper Co., Hopple & Garrard, Cincinnati 25, Ohio
Lodge & Shipley Co., The, Cincinnati 25, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Simonds Saw & Steel Co. (Knives), 470 Main St., Fitchburg, Mass.

SHEARS, Squaring

Cincinnati Shaper Co., Elam and Garrard Aves., Cincinnati, Ohio
Lodge & Shipley Co., The, Cincinnati 25, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Simonds Saw & Steel Co. (Blades), 470 Main St., Fitchburg, Mass.

SHEET METALS—See Strip and Sheet, Ferrous, Non-ferrous

SHIM STOCK
Laminated Shim Co., Inc., Glenbrook, Conn.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.

SHOP FURNITURE—See Furniture, Shop

SLITTING MACHINES, Rotary
Bliss Co., E. W., Canton, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

SLOTTERS—See Shapers, Vertical and Slotters

SOCKETS—See Drill Sleeves and Extension Holders

SOLENOIDS
Allen-Bradley Co., 1331 S. 1st St., Milwaukee 4, Wis.
Barnes, John S. Corp., Rockford, Ill.
General Electric Co., Schenectady, N. Y.
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
Vickers, Inc., Detroit 32, Mich.

SPECIAL MACHINERY AND TOOLS
Axelson Mfg. Co., 6160 S. Boyle Ave., Los Angeles 58, Cal.
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Baldwin-Lima-Hamilton Corp., Eddystone Div., Philadelphia 42, Pa.
Baldwin-Lima-Hamilton Corp., Lima Hamilton Div., Hamilton, Ohio
Baker Bros., Inc., Sta. F., P.O. Box 101, Toledo 10, Ohio
Bath, Cyril Co., Aurora & Solon Road, Solon, Ohio
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., 201 S. Water St., Rockford, Ill.
Baush Machine Tool Co., 156 Wason Ave., Springfield 7, Mass.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Blanchard Mch. Co., 64 State St., Cambridge, Mass.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Buhr Mch. Tool Co., 835 Green St., Ann Arbor, Mich.
Chambersburg Engrg. Co., Chambersburg, Pa.
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio
Colonial Broach & Machine Co., P.O. Box 37, Harper Sta., Detroit 13, Mich.
Columbus Die-Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Consolidated Mch. Tool Corp., Rochester, N. C.
Coulter, James, Machine Co., Bridgeport 5, Conn.
Cross Co., Detroit, Mich.
Erie Foundry Co., Erie, Pa.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Farrel-Birmingham Co., Inc., 25 Main St., Ansonia, Conn.
Federal Machine & Welder Co., Overland Ave., Warren, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, Geo., Mch. Co., 1110 W. 13th St., Racine, Wis.
Greenlee Bros., & Co., 12th and Columbia Aves., Rockford, Ill.
Hannifin Corp., 501 S. Wolf Rd., Des Plaines, Ill.
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lake Erie Engrg. Corp., Kenmore Station, Buffalo, N. Y.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Modern Industrial Engrg. Co., 14230 Birwood, Detroit 4, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
Morris Machine Tool Co., Inc., 946-M Harriet St., Cincinnati 3, Ohio
National Acme Co., 170 E. 131st St., Cleveland, Ohio
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
National Twist Drill & Tool Co., Rochester, Mich.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Robbins, Omer E. Co., 24800 Plymouth Rd., Detroit 39, Mich.
Seneca Falls Mch. Co., Seneca Falls, N. Y.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Sundstrand Mch. & Tool Co., 2531 11th St., Rockford, Ill.
Universal Engrg. Co., Frankenmuth 2, Mich.
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.

(Continued on page 378)

S Product Directory

Waltham Machine Works, Newton St., Waltham, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

SPEED REDUCERS

Barnes, John S. Corp., Rockford, Ill.
Boston Gear Works, 320 Main St., North Quincy 71, Mass.
Brad Foote Gear Works, 1309 So. Cicero Ave., Chicago 50, Ill.
Cleveland Worm & Gear Co., 3249 E. 80th St., Cleveland, Ohio
Cone Drive Gear Div., 7171 E. McNichols Rd., Detroit 12, Mich.
DoAll Co., Des Plaines, Ill.
Farrel-Birmingham Co., Inc., 25 Main St., Ansonia, Conn.
General Electric Co., Schenectady, N. Y.
Horsburgh & Scott Co., 5114 Hamilton, Cleveland, Ohio
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
Philadelphia Gear Works, Inc., Erie Ave., and G. St., Philadelphia, Pa.
Reliance Elec. & Engrg. Co., 1200 Ivanhoe Rd. Cleveland 10, Ohio

SPINDLES, Machine

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th-N. St., Richmond, Ind.
Pope Mchry. Corp., Haverhill, Mass.
Standard Electrical Tool Co., 2488-90 River Road, Cincinnati, Ohio
Wadell Equip. Co., Clark, N. J.

SPRAYING EQUIPMENT, Metal

Metallizing Engrg. Co., Westbury, N. Y.

SPROCKETS—See Gears, Cut

STAMPINGS, Sheet Metal

Dayton Rogers Mfg. Co., Minneapolis, Minn.
Laminated Shim Co., Inc., Glenbrook, Conn.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

STEEL, Cold Rolled, Stainless, High-Speed, Tool, Etc.

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Pa.
Columbia Tool Steel Co., Chicago Hts., Ill.
Crucible Steel Co. of America, Oliver Bldg., Pittsburgh 30, Pa.
Cumberland Steel Co., 101 Williams St., Cumberland, Md.
Ryerson, Jos. T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.
Timken Roller Bearing Co., Canton, Ohio
U. S. Steel Corp. (American Steel & Wire Co.), Div., 436 7th Ave., Pittsburgh, Pa.
Vanadium-Alloys Steel Co., Latrobe, Pa.

STEEL DISTRIBUTORS

Ryerson, Jos. T., & Son, 16th & Rockwell St., Chicago 8, Ill.

STOCKS AND DIES

Cyril Bath Co., Solon, Ohio
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Landis Mch. Co., Waynesboro, Pa.
Threadwell Tap & Die Co., Greenfield, Mass.

For more information fill in page number on Inquiry Card, on page 259

STRAIGHTEDGES—See Machinists' Small Tools

STRAIGHTENERS, Flat Stock and Wire
Bliss Co., E. W., Canton, Ohio
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

STRIP AND SHEET, Ferrous
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Pa.
Crucible Steel Co. of America, Oliver Bldg., Pittsburgh 30, Pa.
Ryerson, Jos. T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., (American Steel & Wire Co. Div., Carnegie-Illinois Steel Corp., Div., Columbia Steel Co., Div., Tennessee Coal, Iron & R. R. Co., Div.), 436 7th Ave., Pittsburgh, Pa.

STRIP AND SHEET, Non-ferrous
American Brass Co., 25 Broadway, New York, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
Bridgeport Brass Co., Bridgeport, Conn.
New Jersey Zinc Co., 160 Front St., New York N. Y.
Ryerson, Jos. T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.

STRUCTURAL SHAPES
Bethlehem Steel Co., Bethlehem, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson, Jos. T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., 525 Wm. Penn Pl., Pittsburgh, 30, Pa.

STUD SETTERS—See Screwdrivers, etc.

SUPERFINISHING EQUIPMENT
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.

SURFACE PLATES
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Bryant Chucking Grinder Co., Springfield, Vt.
Challenge Mchy. Co., Grand Haven, Mich.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
DoAll Co., Des Plaines, Ill.
South Bend Lathe Wks., South Bend 22, Ind.

SWITCHES, Limit
Allen-Bradley Co., 1331 So. 1st St., Milwaukee, Wis.

TACHOMETERS—See Indicators, Speed

TAP HOLDERS
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Cleveland Automatic Mch. Co., 4932 Beech St., Cincinnati 12, Ohio
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th - N Sts., Richmond, Ind.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.

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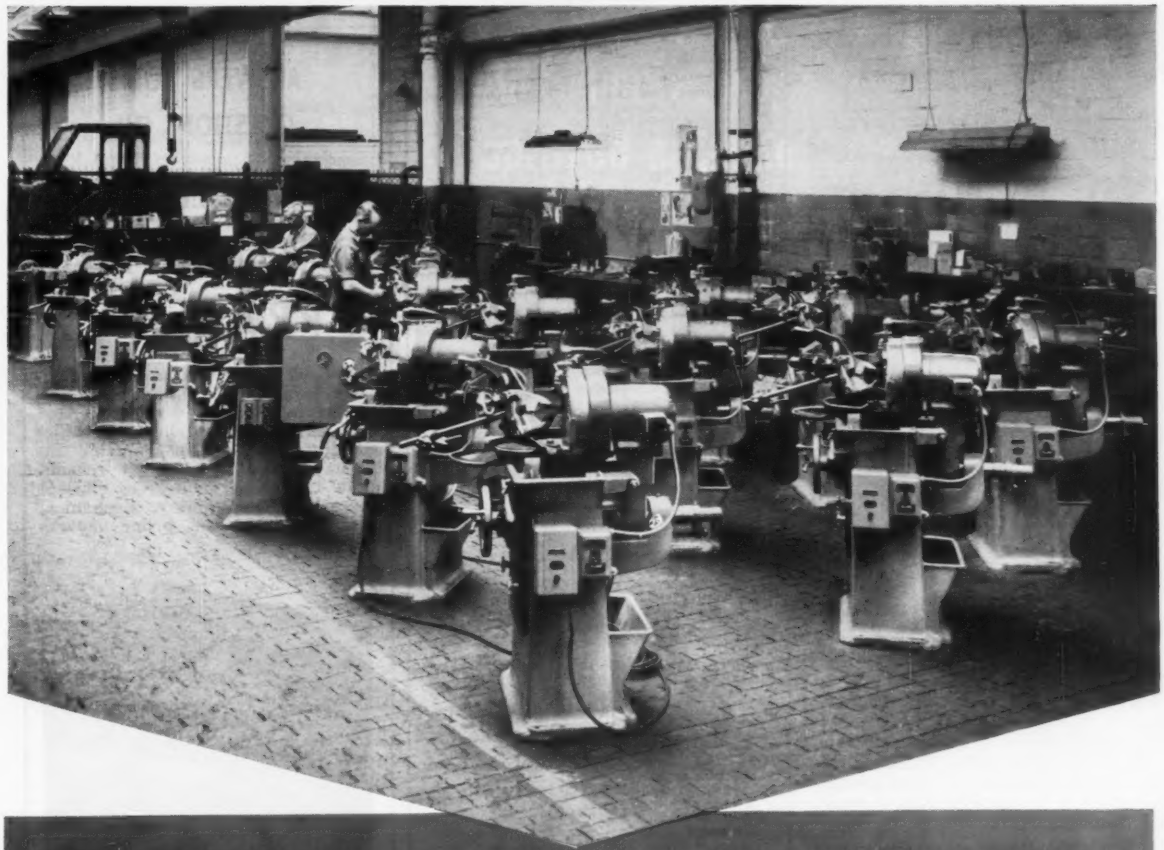

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TAPPING HEADS

Baker Bros., Inc., Station F, P. O. Box 101, Toledo 10, Ohio
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Errington Mechanical Laboratory, 24 Norwood Ave., Stapleton, Staten Island, N. Y.
Ettco Tool Co., Inc., 592 Johnson Ave., Brooklyn, N. Y.
Homestrand Inc., Larchmont, N. Y.
LaSalle Tool, Inc., 3480 E. Outer Drive, Detroit 34, Mich.
Leland-Gifford Co., 1425 Southbridge St., Worcester, Mass.
National Automatic Tool Co., S. 7th - N Sts., Richmond, Ind.
Thriftmaster Products Corp., 1076 N. Plum St., Lancaster, Pa.

TAPPING MACHINES

Baker Bros., Inc., Station F, P. O. Box 101, Toledo 10, Ohio
Baush Machine Tool Co., 15 Wason Ave., Springfield 7, Mass.
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Cincinnati Bickford Div. of Giddings & Lewis Mch. Tool Co., Oakley, Cincinnati 9, Ohio
Chicago Pneumatic Tool Co., New York 17, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Elox Corp. of Mich., 1830 Stephenson Highway, Royal Oak 3, Mich.
Ettco Tool Co., Inc., 592 Johnson Ave., Brooklyn, N. Y.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Kaufman Manufacturing Co., Manitowoc, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Landis Mch. Co., Waynesboro, Pa.
LaSalle Tool Inc., 3840 E. Outer Drive, Detroit 34, Mich.
Le Maire Tool & Mfg. Co., Dearborn, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
Morris Machine Tool Co., Inc., 946-M Harriet St., Cincinnati 3, Ohio
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio
Western Machine Tool Works, Holland, Mich.

TAPS, Hand, Machine Screw, Pipe, etc.

DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Hy-Pro Tool Co., New Bedford, Mass.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio
Threadwell Tap & Die Co., Greenfield, Mass.
Winter Bros. Co., Rochester, Mich.

TAPS, Collapsing

Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

THREAD CUTTING MACHINES

Davis & Thompson Co., 4460 W. 124th St., Milwaukee 10, Wis.
Eastern Mch. Screw Corp., New Haven, Conn.
Errington Mach. Lab. Inc., 24 Norwood Ave., Staten Island 4, N. Y.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Dayton 1, Ohio

THREAD CUTTING TOOLS

Armstrong Bros. Tool Co., 5200 Armstrong Ave., Chicago, Ill.
Eastern Mch. Screw Corp., New Haven, Conn.
Hanson-Whitney Co., 169 Bartholomew Ave., Hartford 3, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

THREAD ROLLING DIES—See Dies, Thread Rolling

THREAD ROLLING EQUIPMENT

Hartford Special Machinery Co., 287 Homestead Ave., Hartford, Conn.
Landis Machine Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
National Machinery Co., Tiffin, Ohio
Reed Rolled Thread Die Co., P. O. Box 350 Worcester 1, Mass.
Sheffield Corp., Dayton 1, Ohio
V & O Press Co., Hudson, New York

TOOL CONTROL BOARDS

Cross Co., 3250 Bellevue, Detroit 7, Mich.
Royal Design & Mfg. Inc., 4133 E. 10 Mile Rd., Centerline, Mich.
Scully-Jones Co., 1906 S. Rockwell St., Chicago 8, Ill.

TOOL HOLDERS

Apex Tool & Cutter Co., Inc., 235 Canal St., Shelton, Conn.
Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Burg Tool Mfg. Co. Inc., Gardena, Calif.
Cleveland Automatic Mch. Co., 4932 Beech St., Cincinnati 12, Ohio
Cleveland Twist Drill Co., 1242 E. 49th St. Cleveland 14, Ohio
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Eastern Mch. Screw Corp., Truman & Barclay Sts., New Haven 6, Conn.
Eclipse Counterbore Co., 1600 Bonner Ave., Ferndale, Mich.
Lovejoy Tool Co., Inc., Springfield, Vt.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio
R & L Tools, 1825 Bristol St., Philadelphia 40, Pa.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill. (Turret)
Vascoloy-Ramet Corp., Waukegan, Ill.
Walton Co., Hartford 10, Conn.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

TOOL MATERIAL, Cast Non-Ferrous Alloy

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5200 W. Armstrong Ave., Chicago, Ill.
Haynes Stellite Co., 725 So. Lindsay St., Kokomo, Ind.
Lovejoy Tool Co., Inc., Springfield, Vt.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, Cemented Carbide

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Apex Tool & Cutter Co., Inc., 235 Canal St., Shelton, Conn.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 30, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Eclipse Counterbore Co., 1600 Bonner Ave., Detroit 20, Mich.
Kennametal, Inc., Latrobe, Pa.
Lovejoy Tool Co., Inc., Springfield, Vt.
Metal Carbides Corp., Youngstown 12, Ohio
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

TOOL MATERIAL, Ceramic

Metal Carbides Corp., Youngstown 12, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, High-Speed Steel

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Apex Tool & Cutter Co., Inc., 235 Canal St., Shelton, Conn.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 30, Ill.
Carpenter Steel Co., Reading, Pa.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Crucible Steel Co. of America, Oliver Bldg., Pittsburgh 30, Pa.
du Mont Corp., 289 Wells St., Greenfield, Mass.
Eclipse Counterbore Co., 1600 Bonner Ave., Detroit, 20, Mich.
Lovejoy Tool Co., Inc., Springfield, Vt.
Vanadium Alloys Steel Co., Latrobe, Pa.

TRACING ATTACHMENTS

American Tool Works Co., Cincinnati 2, Ohio
Atlas Press Co., Kalamazoo, Mich.
G & L and Hypro Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch Co., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
Sidney Mch. Tool Co., Sidney, Ohio
Wales-Strippit Co., Akron, N. Y.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio

TRANSFER MACHINES, Automatic—
See Multiple-Station Machines

TRANSMISSION, Variable Speed

Allis-Chalmers Mfg. Co., Milwaukee Wis.
Barnes, John S. Corp., Rockford, Ill.
Boston Gear Wks., Quincy, Mass.
Cleveland Worm & Gear Co., 3249 E. 80th St., Cleveland 4, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Reliance Electric & Engrg. Co., 1047 Ivanhoe Rd., Cleveland 10, Ohio
Vickers, Inc., Detroit 32, Mich.

TRUCKS, Material Handling

Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio

TUBE-FLANGING MACHINES

Grant Mfg. & Mch. Co., 90 Silliman Ave., Bridgeport 5, Conn.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.

TUBE FORMING AND WELDING MACHINES

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TUBING, Non-ferrous

American Brass Co., 25 Broadway, New York, N. Y.
Mueller Brass Co., Port Huron 34, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.
Ryerson & Son, Inc., Jos. T., 2559 W. 16th St., Chicago 18, Ill.

TUBING, Steel

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Babcock & Wilcox Co., Beaver Falls, Pa.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co. of America, Henry W. Oliver Bldg., Mellon Square, Pittsburgh 22, Pa.

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National Tube Div., U. S. Steel Corp., 525 Wm. Penn Place, Pittsburgh, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson, Jos. T., & Son, 2559 W. 16th St., Chicago 18, Ill.
Timken Roller Bearing Co., Canton, Ohio

TUBE & PIPE CUTTING-OFF MACHINES
Grieder Industries, Inc., Bowling Green, Ohio

ULTRASONIC MCH. TOOLS
Sheffield Corp., Dayton 1, Ohio

UNIT HEATERS, Electric
General Electric Co., Schenectady, N. Y.

VALVE CONTROLS
Barnes, John S. Corp., Rockford, Ill.
Logansport Mch. Co., Inc., Logansport, Ind.
Philadelphia Gear Works (Motorized), Erie Ave. and G St., Philadelphia, Pa.
Vickers, Inc., Detroit 32, Mich.

VALVES, Air
Hannifin Corp., 510 S. Wolf Rd., Des Plaines, Ill.
Hunt, C. B., & Son, Inc., 1911 E. Pershing St., Salem, Ohio
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.
Mead Specialties Co., 4114 N. Knox Ave., Chicago 41, Ill.
Ross Operating Valve Co., 110 E. Golden Gate Ave., Detroit 3, Michigan.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

VALVES, Hydraulic
Barnes, John S. Corp., Rockford, Ill.
Denison Engrg. Co., 1160 Dublin St., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hunt, C. B., & Son, 1911 E. Pershing St., Salem, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio
Logansport Machine, Inc., 810 Center Ave., Logansport, Ind.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Incorporated, Division of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Watson-Stillman Co., Roselle, N. J.
Wood, R. D. Co., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

VERNIERS—See Calipers, Vernier; Gages, Vernier

VISES, Machine
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Modern Mch. Tool Co., 2005 Losey Ave., Jackson, Mich.
Producto Mch. Co., 990 Housatonic Ave., Bridgeport, Conn.
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Hghts. Blvd., Detroit 20, Mich.

WELDING EQUIPMENT, Arc

General Electric Co., Schenectady, N. Y.
Lincoln Electric Co., 22801 St. Clair Ave., Cleveland, Ohio
Linde Co., New York 17, N. Y.

WELDING EQUIPMENT, Gas

Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y.
Linde Co., New York 17, N. Y.

WELDING EQUIPMENT, Resistance

Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
Federal Mch. & Welder Co., Warren, Ohio

WELDING POSITIONERS

Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.

WELDMENTS

Bliss, E. W., Co., Canton, Ohio
Mahon, R. C. Co., Detroit 34, Mich.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.

WIPERS

Scott Paper Co., Chester, Pa.

WIRE

Allegheny Ludlum Steel Corp., Pittsburgh, Pa. (Stainless)
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Pa.
Crucible Steel Co. of America, Henry W. Oliver Bldg., Mellon Square, Pittsburgh 22, Pa.
U. S. Steel Corp., (American Steel & Wire Co. Div., Columbia Steel Co. Div. Tennessee Coal, Iron & R. R. Co., Div.) 436 7th Ave., Pittsburgh, Pa.

WIRE FORMING MACHINES

Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
Nilson, A. H., Machine Co., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, N. J.

WOODWORKING MACHINES

Atlas Press Co., Kalamazoo, Mich.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
Greenlee Bros. & Co., 2136 - 12th St., Rockford, Ill.
Onsrud Machine Works, Inc., Niles, Ill.
Pope Mchry. Corp., Haverhill, Mass.

WRENCHES, Allen, End, Socket, Adjustable, etc.

Allen Mfg. Co., 133 Sheldon St., Hartford 2, Conn.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago, Ill.
Chicago Pneumatic Tool Co., New York 17, N. Y.
Standard Pressed Steel Co., Jenkintown, Pa.
Williams, J. H., & Co., 400 Vulcan St., Buffalo 7, N. Y.

WRENCHES, Power Chuck

Cushman Chuck Co., 806 Windsor St., Hartford 2, Conn.

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Highly absorbent Scott Wipers* are Perf-embossed® . . . a special process that imparts thorough cleaning action, faster liquid absorption. They're 2-ply paper, welded for strength—ideal for jobs like wiping this giant radial drill machine.

*PATENT PENDING

WIPER PROBLEM? Look what Continental-Diamond Fibre did with Scott Wipers!

Continental-Diamond Fibre Corporation, Newark, Delaware, makes products for the electrical and communications industries. Wanting to get away from unsightly piles of oily cloths—and always conscious of the hazards involved in using cloths around high speed machinery—management switched to Scott Wipers.

Result: a saving of $2,000 a year, better control of wiping materials, cleaner, neater plant appearance, reduced accident rate. Scott Wipers, fresh from the box, carry no foreign particles to cut or scratch—are always handy to each work station. Disposal is easy, in nearby receptacles.

Scott Wipers are found to be ideal for nearly 95% of all wiping jobs here. They're used on milling machines, lathes, drills, punch presses, on machines that do skiving, extruding, slitting and winding.

For more facts on lint-free, efficient Scott Wipers, call your local Scott representative. Or write Scott Paper Company, Department M-77, Chester, Pennsylvania.

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